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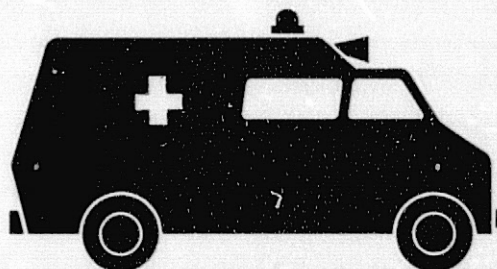
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INTERNATIONAL CONFERENCE ON
REMOTE EMERGENCY MEDICAL SERVICES

NASA Lyndon B. Johnson Space Center
Texas Tech University School of Medicine
Texas Tech University College of Engineering

CONFERENCE CHAIRMAN
William M. Portnoy, Ph.D.

May 15-17, 1975

Lubbock, Texas

CHARACTERIZATION OF AN EMERGENCY MEDICAL SYSTEM

Session Chairman: Martin D. Keller, M.D., Ph.D.

Evaluating the Effectiveness of an Emergency Medical System

Thomas R. Willemain, Ph.D.

The Emergency Physician and the Emergency Medical Services System

Harris B. Graves, M.D.

Evaluating the Effectiveness of an Emergency Medical System

Thomas R. Willemain, Ph.D.*

Evaluation of emergency medical services (EMS) has not been a frequent, careful or popular activity in the past. The requirements of the EMSS Act will do much to increase the frequency of evaluations, but only a strong sense of objectivity can improve the care with which evaluations are conducted, and perhaps nothing can improve their popularity, especially with the line personnel whose performance is to be reviewed. The evaluations required by the EMSS Act may eventually confront directly the issues of morbidity and mortality reduction, but at least initially they will focus on documenting the existence of an EMS system and perhaps monitoring the efficiency with which it operates. The more interesting and more difficult questions of effectiveness will be addressed later, if at all.

It would certainly be convenient if questions of effectiveness would just go away, and in a certain sense they can. It is hard to imagine the typical local EMS organizations developing and applying a sound experimental design to provide definitive answers to clinical issues with EMS planning significance. These organizations are not

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meant to perform such functions and should not be expected to. This is not to say that EMS providers should be permitted to remain at the "inventory-taking" level of evaluation, fixated on the statics of their EMS system and ignoring the process dynamics which are at least partially under their control: ambulance response times, compliance with EMT protocols, critically ill or injured patients' transfer patterns, and so forth. If emergency medical services are really as important as those who work in them claim, then simple notions of accountability and professionalism demand that the dynamics of system operation be monitored and reviewed. This in turn requires a commitment of resources to data collection and processing that, historically, most EMS providers have failed to make. The reasons for the failure may have as much to do with a reluctance to document service failures as with tight budgets or distaste for paperwork. With the passage of the EMSS Act, however, the situation has changed noticeably. Now, it does not seem difficult to find an outside organization or firm more than willing to record, keypunch and crosstabulate anything that moves within an EMS region. While this greatly increases the availability of data, it is not clear that the essential feedback connections are being established, i.e., that changes in system operation are being made on the basis of data analysis. Certainly it is more difficult for performance monitoring to be assimilated into day to day system operations when the locus of data analysis is distinct from that of service provision. Only infrequently have EMS providers spontaneously developed a viable data based planning and management capability, and perhaps such services should be singled out for special study by those

who evaluate evaluations. In any event, the task of process measurement, as distinct from effectiveness measurement, is of sufficient importance and difficulty that most EMS service providers should be excused from the latter to concentrate on the former. Not only would this permit much necessary business to be completed, it would probably prevent a good deal of low quality work while nonetheless creating a more receptive climate for serious outcome evaluation.

Nevertheless, it is neither possible nor desirable to segregate the study of outcome from the study of process. In an ideal world, the link between process and outcome would be known, explicit outcome standards would exist, and EMS planners could derive (rather than invent) process guidelines, which EMS providers could then cheaply and routinely monitor. In reality, the links between process and outcome are poorly understood, and there is an arbitrariness about those process guidelines which are advanced. The guideline in the EMSS Act that 95% of ambulance trips reach at least a low level emergency facility within 60 minutes has almost no force in an urban or suburban setting; in a rural setting, it is not clear why the 60 minute criterion is preferable to a 45 minute criterion which might save a few more lives while adding greatly to system costs, but good estimates of the added costs and lives saved are lacking. Careful evaluative studies could provide these estimates, but the core of EMS system planning would begin--not end--with the estimates.

The notion of EMS evaluation evokes so many stereotypical images --of ivory tower evaluators who faint at the sight of blood, of impetuous emergency care innovators who turn purple at the sight of statistics, or of niggling federal bureaucrats who live on budgets and

regulations--that very often we lose sight of the paramount task of valuation that surrounds evaluation. Suppose for a moment that the perfect experimental design had been concocted and all the right data were available. Do we know what to do with the perfect data base? How would we react to solid information that a new EMS system would cost an additional \$1 million and save 10 lives that would otherwise be lost?

We might all quickly mutter that there is no price tag on human life, but one or another of us would sooner or later divide the \$1 million by the 10 lives and introduce a new number into the problem: \$100,000 per life saved. This is an uncomfortably large number, which we can only interpret favorably by linking the name of someone we love or hold important--mothers and presidents may come cheap at \$100,000, but not John Doe's. Part of our discomfort at the figure would surely follow from the realization that there are other good works which the \$1 million could support, such as a fine emergency room to treat tens of thousands of patients, some with life-threatening emergencies but most with serious if non-fatal problems.

Now if we did not have the \$1 million to spend we could escape the dilemma, but our society frequently robs Peter (when no one is watching) to pay Paul, so our not trying to find the \$1 million might create a moral problem of its own. If we already had the fine emergency room, our problem would be simplified, since we would only have to deal with that most fundamental (and difficult) of public safety questions: "How much is enough?" In practice, though, it appears that we seldom have scruples about introducing critical care

capability into regions which are also weak in basic emergency services. On the contrary, we seem quite willing to jump far out on the curve of diminishing returns without first plodding through the simple but cost-effective steps.

One can offer a few explanations for this behavior. Perhaps our psyches require the rarified atmosphere of the glamorous, specialized programs; to be known as a journeyman is to be at once praised and derided. We may honestly feel that the more exotic EMS programs will serve to galvanize the EMS community, while in fact they may be more likely to deflect its attention from basic needs and services. With regard to rural areas, we may subscribe to the belief that compensatory spending for technology and facilities is necessary to equalize access to top quality emergency care. The power of this last argument is closely tied to the efficacy of high-level emergency care. If our intensive care units, 1000 hour paramedic training programs and hierarchical categorization schemes were clear and significant improvements over less intensive emergency care systems, then equity considerations would indeed dictate their extension, at great expense, to rural areas. However, in the absence of compelling evidence that exotic EMS is cost-effective, the argument turns around. While all regions deserve some minimal level of services, each citizen should receive roughly the same commitment of resources, the same level of effort. Inevitably, this means that citizens in sparsely populated areas must accept a greater level of risk, for diminishing the risk of one rural citizen may be as costly as diminishing the risk of more than one city dweller. The point is not that urban citizens are

more important than rural citizens; quite the contrary, the point is that all citizens should be valued equally, and that this necessarily puts rural EMS at a disadvantage.

The main conclusion of this discussion of valuation is a simple but much neglected idea: it may be a mistake to invest EMS resources in an apparently worthwhile program. One will always be hearing arguments for new programs that may well save a few precious lives; in fact, the planning choices will nearly always be from among "good" programs. The planner's responsibility, however, is to be critical and weigh fully both cost and effectiveness. For instance, the concept of emergency facility categorization has much intuitive appeal. But there is--despite the positions taken by some national organizations--more than one way to categorize, and an inflexible or dogmatic approach to categorization could create so much institutional friction and planning overhead that, in the end, it might be preferable to spend time other ways. Mobile coronary care may save some number of cardiac patients, but the investment in coronary care may deflect resources from non-cardiac patients who also have a right to our attention. Despite the understandable claims of program advocates, these decisions are rarely simple. What is wise in the context of one community may be foolish in the context of another, yet we rarely hear a description of the circumstances in which a "leading" community's "model" EMS system would not work. It is probably foolish to be "against" statewide trauma networks in the abstract, but it may also be prudent to not be too much "for" them in particular circumstances. Without adequate evaluation of the efficacy and cost of statewide

trauma networks, the EMS planner should at least keep an open mind about whether this "good" program deserves priority over other "good" programs. The fundamental question of "how much is enough" will never go away. We can pretend it does by adjusting our blinders to exclude from view anything beyond the EMS system, or even anything beyond the ambulance or emergency room, but the overall goal of social welfare will remain, and EMS programs are still only one means to that end.

Having first discussed the valuation problem because it is the more fundamental and is equally misunderstood, consider briefly now the less subjective and more technical issues of evaluation. One can distinguish among input, process and outcome evaluation. Input measures, which merely tally resources in place (e.g., ambulances per capita), should no longer be the sole evaluative indices for EMS systems. Every operating system should at least keep track of process measures, such as vehicle response times or the match between level of care needed and level of care received. While process measurement avoids the questions of efficacy inherent in outcome measurement, it is responsive to the notion that EMS should be efficiently provided.

It is important to note the role which mathematical models of system operation can play in assisting process evaluation. In some cases, the mathematical structuring of the process directly provides the evaluative methodology. A case in point is the analysis of telephone screening of calls for ambulance service performed by Stevenson and Willemain [see bibliography for specific mathematical studies and also for general titles on evaluation]. Their modeling work outlines an efficient data collection methodology which permits before and after testing of the impact of a call screening program on two

"resource matching" parameters: the probability that a true emergency call will receive emergency service and the probability that a non-emergency call will receive non-emergency service. The model illustrates several fundamental features of call screening, including the fact that acceptable screener error rates depend on the number of vehicles and their workloads. Other mathematical models provide normative information for process evaluation by predicting vehicle utilizations and response times from the number and location of vehicles deployed; the work of Stevenson, of Hoey, and of Jarvis, Stevenson and Willemain provide examples.

Finally, consider outcome evaluation. Slowly, the state of this art is advancing to the point that costs and lives saved can be estimated for various FMS programs. The primary emphasis must be empirical, but again mathematical models can be of great use in both planning and evaluation. Consider the case of mobile coronary care units (MCCU's). In a field trial, the number of pre-hospital cardiac deaths may decline after introduction of the MCCU. A careful evaluation requires not only that this pre/post difference be noted, but also that the lower death rate be actually attributed to the MCCU. The publicity attendant on the introduction of the MCCU may well change the public's response to cardiac symptoms, which may itself explain a good deal of the change in outcome. To unravel the effects of patient response from those of system response may be very difficult or impossible in a poorly designed experiment. Cretin has developed a mathematical model of the risk of death from myocardial infarction which illustrates the relative importance of patient response and system response. Beyond its use in

evaluation, however, the model provides a way of translating a given reduction in pre-hospital mortality into a change in more fundamental measures, such as 1 and 5 year mortality and life expectancy. It provides quantitative estimates of the limitations imposed on MCCU's by inappropriate public response, and the full set of model outputs are useful both for comparing preventive, pre-hospital and in-hospital strategies and for the generation of process guidelines. While a full discussion of Cretin's work is impossible here, it is important to note the potentially significant impact of mathematical models on EMS evaluation. Such models will surely force on us the kind of valuation issues which both precede and follow the evaluation process.

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THE EMERGENCY PHYSICIAN AND THE EMERGENCY
MEDICAL SERVICES SYSTEM

HARRIS B. GRAVES, M.D.

Until recently the provision of emergency medical care in the United States has not been the product of a concerted, organized or coordinated effort to provide high quality emergency health services in all parts of the country. Instead, many services of high quality exist and contrast with many others of low quality. Growing interest nationally has, however, caused some significant changes. Paramount among these changes is the development of a true system of providing emergency medical care; a system that, to one fashion or another, can be provided to everyone in the United States.

For those of us who are extensively involved with emergency medical services on a day-to-day basis, it is temptingly easy to look only at the statistics and the dollar signs to see how well we are progressing in improving emergency medical services. But, if we would only travel sixty miles from any "center of emergency

medical services excellence" we could easily see how much more work remains to be done. In fact, if a close look is taken at the "centers of EMS excellence" quality of care, we could find work to be done there also.

Although a total emergency medical services system may not be present in every community, every community does have the essential building blocks for the development of a total system. For example: the manpower is available, but it is often untrained; the ambulances are there, but are poorly equipped and designed. For our purposes, we will define an emergency medical services system as having eight elements--each element having sub-elements:

1. Detection of the incident
 - A. Public education in the recognition of the need for care
2. Notification of the incident is given to the proper authority
 - A. Establishment of the nation-wide emergency number--911
 - B. Central dispatch or coordinating center for all emergency services (police, fire, and emergency medical services)
3. Dispatch of the appropriate assistance
 - A. Central dispatch or coordinating center
 - B. Adequate radio and telecommunications capabilities

4. Proper on-site care administered
 - A. Training of emergency personnel
 - B. Public training in basic life support
5. Transportation of the patient to the correct medical facility
 - A. Adequately equipped and designed vehicles
6. Care administered in the emergency facility
 - A. Training of the emergency facility staff
(RN and MD)
 - B. Categorization of a hospital's capabilities
for specialized care
7. Definitive care
 - A. Adequate support facilities in the hospital
(ICU, CCU, etc.)
8. Overall evaluation of the quality of care
 - A. Standard ambulance reporting forms
 - B. Physician evaluation of quality of pre-hospital
and emergency department care
 - C. System evaluation of overall medical care

What is the emergency physicians role in the community emergency medical services system? Before we answer that question let me ask another: What is an emergency physician?

An Emergency Physician can be described as a physician who devotes, on a regular basis, either a full or part-time portion of his

medical practice to the care of the acutely ill or injured patient.

This definition, by design, encompasses many more physicians than those of us who would limit the definition to "the full-time practice of emergency medicine." Rural physicians, are, in fact, the full-time emergency staff for their communities. Logically, all physicians dealing with emergencies must be completely up-to-date in their emergency skills.

The responsibilities of the emergency physician to the total emergency medical services system include the ability:

1. To provide the emergency medical care for the community, 24 hours a day, to all patients with acute illness or trauma
2. To evaluate the patient's emergency needs, stabilizing the patients with life-threatening conditions, and to provide the other necessary services that may be immediately indicated
3. To provide, to those patients not requiring hospitalization, the initiation of necessary definitive care
4. To properly administer the emergency facility (this may be a single room in rural hospitals or a large department in urban centers) to insure that the necessary

personnel, equipment, and supplies are immediately available to meet both the routine and emergency demands

5. To provide the necessary leadership in the community for the improvement of emergency medical care, pre-hospital and in-hospital
6. To undertake the responsibility for establishing and participating in the training of emergency medical services personnel to provide these personnel with the necessary skills to successfully handle life-threatening situations
7. To plan, and practice, the community's response to catastrophic or disaster conditions
8. To continually evaluate the system to provide the best possible emergency medical care, within the available resources of the community

The emergency physician is a logical choice as the leader of the emergency medical services system. However, to undertake this key role he must be well motivated, well trained, and have a full understanding of the emergency medical needs and capabilities of the community.

The American College of Emergency Physicians, an organization of some 5,500 physicians with an expressed interest in emergency medicine has since its inception in 1968 dedicated itself to the overall improvement of emergency medical care. Because of that we require of ourselves that we attend a minimum of 150 hours of continuing education courses each three years and we provide accredited educational programs designed to meet these requirements.

We believe that one of the most important factors in improving emergency care is the training and education of all personnel involved. No ambulance, no defibrillator, no radio, no computer is of any value if the people are not trained to take full advantage of these sophisticated pieces of equipment.

Because of that, ACEP believes that education and training must reach every segment of the emergency medical services system. It must involve physicians and medical students, nurses and nursing students, ambulance attendants, dispatchers, law enforcement officers, firemen, and most certainly the public itself.

ACEP is presently concentrating its efforts on the continuing growth of emergency medicine residency training programs across the country and the ultimate development of a professional board examination to certify competency in emergency medicine. There are presently 32 emergency medicine residency programs training 165 physicians. This number must be markedly increased to meet projected manpower needs.

We also believe that all medical, dental and nursing students

should be taught proper methods of rendering first-aid as well as the basic elements of life-support. This material should be provided early in the educational curriculum and repeatedly reinforced. In addition, advanced emergency methods and techniques should have a structured place in the curriculum of all medical students. Comprehensive training in the breadth of emergency medical problems should be made available to nurses.

Existing national standards must be expanded for the certification of emergency medical technicians, encompassing the various levels of education and training. The practical application of EMT skills, up to this time, has not been satisfactorily examined. Emphasis must be placed by the various state and national certifying agencies to test the actual application of "hands on" skills rather than solely testing memorization. Courses for advanced training should be standardized followed by certification through an appropriate body with mandatory periodic recertification.

Additionally and perhaps most importantly, if we are to have a functioning EMS system public involvement must be included. The public must have:

1. The ability to recognize that an emergency exists (i.e. the 1-5 hour delay with heart attacks)
2. The ability to begin proper emergency care
3. The ability to know how to access the

emergency medical system

4. The knowledge of the available resources of
the local EMS system

Not only must the public become more involved in the system but physicians must be encouraged to give some of their time to the project.

The emergency medical services system is a "product" and is in direct competition with other community and personal "products" such as family, religion, and community organizations. Except for those persons who are paid to be a part of the system, the voluntary contributors must be convinced that the giving of their time is a worthwhile and justifiable expenditure.

What can planners and administrators do to obtain and maintain the necessary physician involvement in your EMS systems.

First, put him in areas where his talents can be used to the best advantage. If he is a teacher, ask him to teach; if he has administrative ability, let him organize.

Realize physician shortcoming such as a paucity of administrative training, minimal time to follow up on administrative details, and a tendency to "talk off the top of their heads."

Urge the physician to be your community spokesman.

When the physician is involved in emergency medical technician training programs course coordinators can again do several things to assist the physician.

1. Provide the physician with appropriate

background material about the EMT training course.

2. Give the physician the xeroxed copies of the pages from the EMT textbook so that he may grasp the level of instruction necessary. This prevents the problem of addressing the EMT class either above or below their heads--both common complaints directed at physicians.
3. Invite the physician with enough lead time to allow him to schedule his presentation well in advance.
4. If you have the time, visit the physician to answer any questions he may have. Otherwise, at least make a phone call.
5. Call and remind the physicians secretary the day before the presentation.
6. Video tape the presentation for re-use at any time without requiring the physicians presence.

Keep the physician informed of progress made in the improvement of EMS, and ask the physician for advice on problems encountered. Make the physician feel needed and the physician will be involved.

There are, however, some questions to be raised about some

areas of the system. These questions will undoubtedly be answered in time, but considerable thought should be given to them before large sums of money are committed.

1. 911 -- Does it really function? ACEP believes it does--and well-- in those communities with central dispatch and an organized system of response. It must be remembered that this is an emergency number, not meant only for medical emergencies or only for elements of medical emergencies such as heart attacks. The number is frequently overloaded by public misuse and instructions for 911 utilization must be disseminated.

On the other hand, there are those who believe that 911 should be used as an emergency number throughout the United States and that it should be answered by someone with a knowledge of emergency response in the area even if no fully organized system is present. To them, it is most disconcerting to dial 911 and receive a recording, a busy signal or no response at all.

2. Categorization of hospitals. ACEP believes that the present method of categorization, although a needed beginning, is not sufficient. A listing of the personnel, facilities and equipment is a necessary step in the evaluation of the hospital's

emergency service but this does not tell us what the hospital can really do. A more functional method is necessary. Even the small community hospital of 30 beds may be "major" emergency hospital for its area.

Perhaps there should be only two categories-- approved or disapproved for emergency services-- depending on whether that particular hospital can show that it can handle (by proper and judicious transfer if necessary) those emergencies it would normally expect to see.

3. Telemetry--is it cost effective? Is it necessary? Does it really improve patient care and outcome? There is a dichotomy of thinking on this subject. The first belief is that no EMT should give advanced life support without voice and telemetric contact with the physician. The second is that the EMT can be trained to a level to function correctly without physician contact. The question here is to assure ourselves that the training is sufficient in all instances. Perhaps telemetry is an intermediate step between strict and total physician control and relative independence of the EMT through standing orders for patient care.

4. Evaluation. Questions have been raised as to whether the Emergency Medical Services System really does what it is supposed to do.

Evaluation of final outcomes of emergency care is in its infancy and this essential component is only now beginning to receive attention. We are confident, however, that through continuous evaluation we will begin to see the actual value of emergency medical care to society.

In any case, we firmly believe that there is little doubt of the necessity that the emergency physician should be predominately involved in all the areas of the system.

As advances are made in the field of emergency care it is clear that no component of the total community emergency medical services system can be regarded as isolated and insulated from the rest of the system.

And if the patient is to have the greatest benefit of all our efforts to improve the delivery of emergency medical care (and I hope that we never lose sight of the fact that the patient is why we are all here) we must all work together, physicians-planners-nurses-ambulance service operators-firefighters-citizens.

COMMUNICATIONS AND EQUIPMENT

Session Chairman: Brigadier General Donald G. Penterman (Retired)

The 911 System

Warren E. Jacobi

Permian Basin Communications Network for Emergency Medical Services

Richard L. Sinderson, Jr.

The Los Angeles County System: An Historical Analysis

James O. Page, J.D.

Satellite-Aided Biomedical Telecommunications

Richard B. Marston, Ph.D.

STARPAHC: A Progress Report

Norman Belasco

THE 911 SYSTEM

Warren E. Jacobi

It is possible to discuss 911 service in terms of a fully functioning system. A more discerning analysis would reveal that 911 is more correctly defined as a subsystem. The full system is the total emergency response capability of the community. The system is highly visible to the public in the form of a cruising police car, roaring fire apparatus, or an ambulance speeding by.

However, when an emergency arises, the public's view of the system is usually the telephone. Now the system acquires a new facet. The resources are available, but how to involve them in the problem? The citizen experiencing or witnessing a crisis event seldom has the presence of mind to select the proper 7 digit telephone number for the agency he needs, in the jurisdiction he is located, from the mass of emergency numbers presented in typical telephone directories.

This, then, is the function of 911. It provides the interface between the public and the emergency response system. 911 is:

One Number	For All Jurisdictions
Easily Remembered	For All Emergencies
Easily Dialed	Answered by Professionals

Further, in a major incident - a serious auto accident - people injured, threat of fire from leaking gasoline, traffic blocked, - Requires response by several agencies. 911 resolves the uncertainty of who to call first. A single call brings total response.

American Telephone & Telegraph Co.

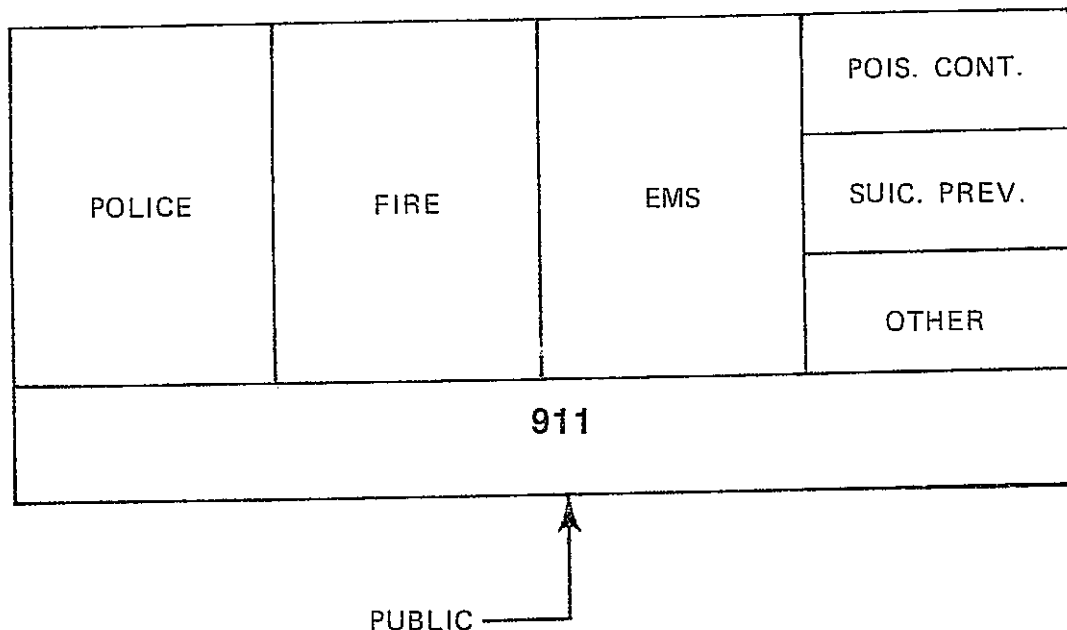


Fig. 1. The Role of 911 in the Emergency Response System

Having thus defined the total system, we can examine the factors involved in the design of a 911 network and explore the communications needed behind the answering point for efficient processing of an emergency call.

It is necessary to introduce here the basic building block of a 911 system - the central office serving area. All the telephones served by a telephone central office are located in a well defined geographical area, which may be large or small depending on population density. When 911 is dialed by any of these telephones the call can be delivered to only one location. Unfortunately for 911 system planners, these areas are constrained by - population density, community of interest, natural barriers or limitations of telephone apparatus. Only rarely is there coincidence of central office and political boundaries. This fact explains why 911 has not been adopted by more communities.

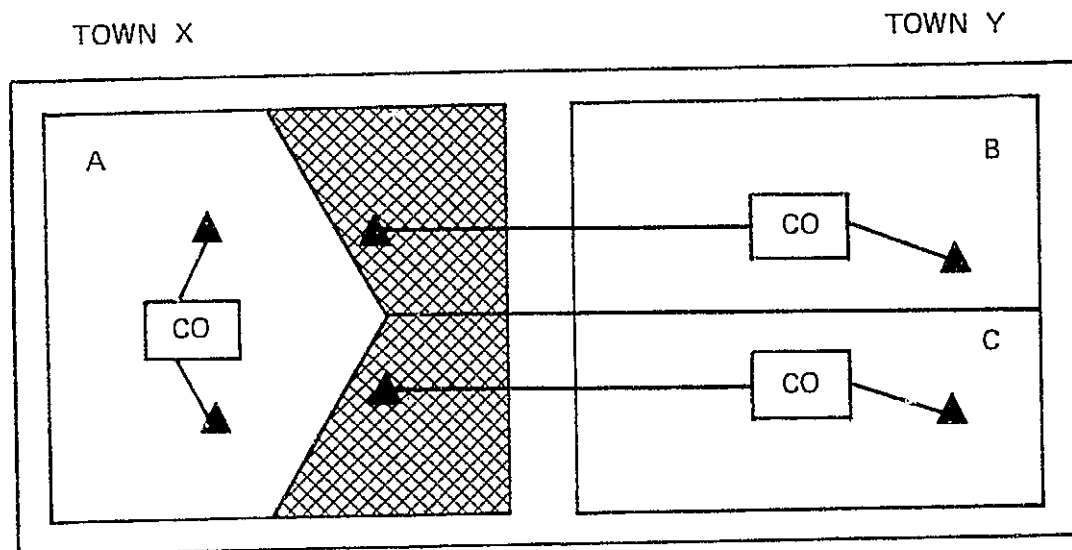


Fig. 2. Jurisdictional Overlap. X-Hatched Areas of Central Office Areas A and B Overlap into Town X.

Although the jurisdictional problem has been a deterrent to a universal 911, the existence of more than 500 systems serving 35 million people at the end of 1974 demonstrates that the problems can be solved. Interagency cooperation is the key to a successful emergency response system linked to the public via 911. Additionally, there should be detailed planning of the necessary communications channels and procedures to insure delivery of the call or the pertinent data to the proper agency with minimum delay.

To encourage cooperation and accumulate data for planning purposes it is desirable to form an "Operations Committee", made up of representatives of all the public safety agencies to be included in the system. The telephone company consultant should be an active member of this committee to define the capabilities of the telephone system and any options available. It has also been found helpful, especially in the larger, more complex systems, to form a 'Steering' or 'Policy Committee'. Composed of citizens apart from the public safety agencies, with the responsibility for setting policies and choosing among the options that may be available to attain the community goals.

In setting the stage for determination of the best 911 system configuration, we have made the assumption that, at least tentatively, the area to be served has been defined. A second tentative decision required is the number and location of the answering points. This information is used by the telephone company representative to prepare a preliminary 911 system plan. The policies governing the telephone company proposals are: (For the Bell System)

- 1.) All modifications and additions to central office equipment necessary to complete 911 calls will be absorbed by the company.
- 2.) Interoffice trunking within the local calling area will be provided without charge.
- 3.) Calls to 911 will be free to the calling and called party.
- 4.) The telephone company will design the system at its option to provide adequate reliable service at the least cost.
- 5.) The subscriber will pay for trunks and equipment to answer 911 calls as provided under existing tariffs.

The plan presented under the guidelines will become the basis for further decisions. The tentative number of answering points can be firmed or modified to best utilize the capabilities of the local telephone network. After the number of answering points has been fixed, traffic studies will be needed to determine the total number of calls received during the busy hour by each of the public safety agencies to be served by the answering point. The average holding time of calls is also needed, to determine the total number of 911 trunks necessary to provide an acceptable level of service. The minimum grade of service recommended is P. 01. That is, one call in a hundred will encounter a busy signal during the busy hour. Better grades of service may be attained by adding additional trunks.

The number of trunks, with a suitable allowance for growth, will determine the capacity of the answering equipment needed. Since most telephone equipment is well adapted to 911 service, the final choice will depend to some degree on the method of operation to be used. In some systems in use today, the 911 operator determines only the agency wanted and, in multijurisdictional systems, the location, and adds on or transfers the call to the proper agency. The serving agency deals directly with the caller, assesses the situation and determines the proper response. This method of operation places the public in direct communication with the serving agency with minimum delay and reserves the decision making function for the agency.

There are also systems where the 911 operator makes the primary response decision and gathers all the data. He then relays to the

dispatcher the necessary facts. This type of procedure frees the dispatcher of involvement in time consuming non-emergency calls. Further when a call does arrive, the dispatcher knows it has already been screened and should be given priority attention.

Of course, it is also possible to combine these two methods in one system. For example, the police may be well served by having incident details relayed to the dispatcher while fire and ambulance calls are best cared for on a transfer basis.

The decision as to method of operation of the 911 answering point rests in part on the nature of the community, but also on the type of personnel answering 911 and, obviously, on the preferences of the participating agencies. The number of 911 trunks, the operational procedures, and the number and type of transfer lines will have to be considered in the final choice of answering point telephone equipment. This may range from a key telephone system, through various types of switchboard to elaborate Automatic Call Distributing Units. Where large numbers of calls are to be transferred or relayed over the switched network, some consideration should be given to automatic dialers and Touch Tone service where it is available. Transmission requirements very often favor the use of private line facilities especially over long distances. With the exchange network as a back-up facility there then exists two means of access to the agency.

In addition to the transfer and relay procedures mentioned, there has been proposed a referral method. In this case, the calling party is given another number to call. While there is a place for referrals in assisting the public with problem that are not true emergencies, we do not believe a referral is an adequate response where human life or property is endangered.

911 Checklist For Action

Planning Decisions —

- Formation of a Planning Task Force
- Review of Existing Info On 911
- Decision About Area to be Served
- Inventory of Emergency Svcs in 911 Area
- Selection of Agencies to be Included
- Location of Answering Center
- Answering Center Design Decision
- Equipment Specifications

Fig. 3

When 911 was first proposed it was envisioned as a local service. A simple substitution of 911 for existing local seven digit numbers. It was recognized that there would be some overlap problems and, of course, all emergency services would be reached by the single number. However, under the concept of small local systems, the interagency cooperation necessary would involve fewer and more closely related agencies and the number of calls to be relayed or transferred to adjacent jurisdictions would be small and easily managed.

Over the past seven years there has been a tendency to consolidate the emergency response systems. There are several reasons for considering systems covering large areas. There may be manpower economies or more efficient use of available radio frequencies. In the case of Emergency Medical Services in rural areas, facilities may be spread rather thinly and regional support is necessary to provide an adequate level of emergency medical care.

911 can serve regional systems and is flexible enough to adapt to several modes of operation. For illustrative purposes we will consider only two. First, an arrangement that is widely used today. The dispatch function of the participating agencies remain as they were prior to 911.

The new element is a 911 answering point. From the answering point

private lines are extended back to the various dispatches. The arrangement is straight forward but if the area served is very large, there can be some drawbacks. Many communities have duplicate street names and in a large area it is difficult for the 911 operators to know the geography of the area with the familiarity that permits rapid identification of incident locations. This arrangement is shown in Figure 4.

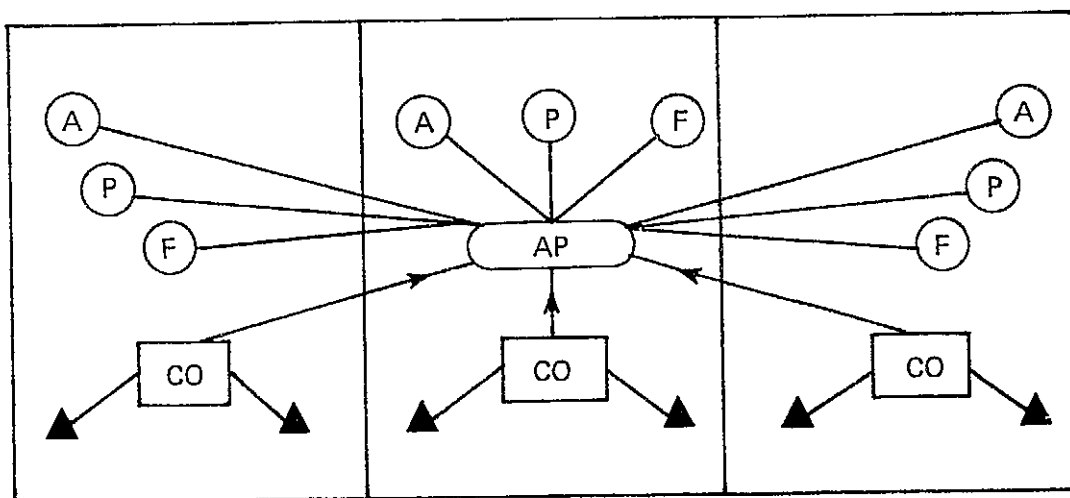


Fig. 4. Hypothetical 911 System. Three Communities, A Single Answering Point. Individual Dispatch.

The contrast to the first example is a similar area served by multiple answering points. To demonstrate a further possibility, the added requirement of a regional emergency medical service will be added. The whole network becomes simpler and if it is a large area the cost could be significantly reduced. The configuration makes use of existing police telephone centers as 911 answering points. This is most often the case in existing systems since the police receive up to 90% of all emergency calls and usually have the facilities and manpower to absorb the other 10%. The police also often control the alerting devices for volunteer fire departments. It is obvious that each local police department receives calls from a localized area and has detailed knowledge of the locale. The dotted lines indicate ancillary channels to local ambulance service in the event of an outage of the circuits linking the answering point to the regional EMS center. This alternate network is shown in Figure 5.

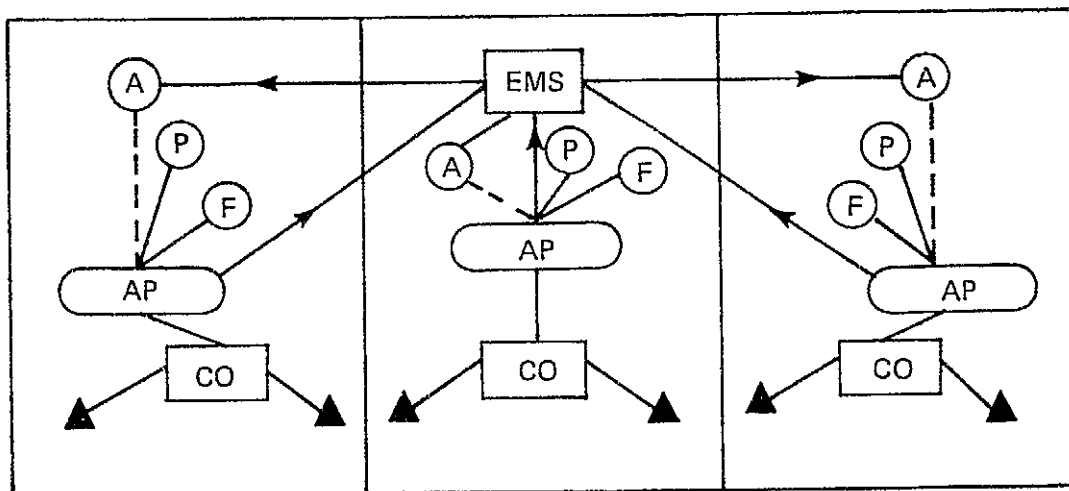


Fig. 5. Hypothetical 911 System. Three Communities.
Individual Answering Points. Consolidated EMS Dispatch.

As networks grow larger and more complex, more attention must be given to reliability. The dial network offers a good back-up to private lines. Whatever the standby procedures and communications channels may be, they should be used often to insure familiarity by operating personnel, to be sure that stand-by equipment will operate when needed and to highlight those areas where inefficiency slows the system down. It is far better to discover problems in a simulated failure when some options are available than during the real thing when nothing can be done on short notice.

It is not possible to review all the possible ways to use the Universal Emergency Number in the short time available. Rather, it was meant to demonstrate that there is no single or 'best' way to incorporate 911 into an emergency response system. 911 has a function and it is in the public interest. The concept is flexible and can be merged into any demographic or geographic situation.

PERMIAN BASIN COMMUNICATIONS NETWORK
for
EMERGENCY MEDICAL SERVICES

Richard L. Sinderson, Jr.

ABSTRACT. An EMS communications network for the 17-county Permian Basin Region of Texas has been proposed in a grant application to DHEW under Public Law 93-154, Section 1203. The proposed communications system provides a coordinated telephone and radio network to link together the various medical facilities, emergency care vehicles, and medical staff, and to provide contact with other public safety agencies. The nationwide 911 emergency request telephone number (fire, police, medical) will provide single entry public access to a Resource Coordination Center (RCC), located in each county seat. The RCC provides a centralized coordination point for all types of public emergencies. Medical emergencies will be coordinated with the Medical Control Center (MCC) such that direct radio communications between the ambulance attendant and the MCC staff can be made for the purpose of medical consultation and direction for at-the-scene or in-transit treatment of the patient. "Patient-care vectoring" decision will also be made by radio to assign the patient's delivery to the nearest or most appropriate hospital considering the specific treatment requirements of the patient. A telephone network will also be implemented to allow immediate direct contact with special care centers (cardiac, burn, poison control, psychiatric, etc.), including the capability to make radio-telephone patches at all RCC's and MCC's.

Voice communications will be by VHF radio but UHF biomedical telemetry will be implemented in the large city areas for transmission of ECG data from heart attack patients. This capability will allow emergency medical technicians to give IV's and to administer stabilizing drugs at the scene or while enroute to the hospital.

A regional RCC and MCC will be established in Odessa to coordinate overall EMS services in the region. All coordination centers will be tied together by a combination of telephone and radio communications.

INTRODUCTION. This paper is a somewhat edited version of the communications section of the proposal submitted to DHEW on March 31, 1975. The

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author of this paper prepared the communications section in cooperation with the Permian Basin Regional Planning Commission.

The system design of a large regional EMS system is a problem primarily involved with the linking together of many different groups, both private and public. Therefore, the real difficulty is not with radio technology per se, but with overall system planning where many persons at diverse locations and over a wide geographical area must be able to communicate with one another in a rapid response manner. The problem involves social, political, and cost/need factors. The communications system is to be utilized by medical personnel, thus requiring simple operating features in the radio equipment. Existing facilities and personnel must be used to a large extent to obtain a cost effective program. Regional system engineering is mandatory to ensure compatibility of all radio systems.

A large effort is necessary to understand the actual emergency care needs in each area of the region as well as the nature of existing facility and personnel resources. Basic communications criteria must be established initially to provide a baseline for subsequent design tradeoff evaluations. In-place regional EMS systems should be surveyed to obtain ideas on various design alternatives and to obtain information on specific problems that were experienced under actual operations.

Much of the material gathered and developed for the Permian Basin proposal would be applicable for other regions, especially rural ones. The length of this paper is considered justified only because much of the information could be utilized by other groups desirous of planning comprehensive EMS systems.

EMS COMMUNICATIONS GOAL. The goal of EMS communications is to develop the necessary system which is functional on a daily operational basis and in disaster situations, and which can coordinate emergency medical resources and public safety services required for the most appropriate care and transportation of the patient.

CURRENT STATUS OF PERMIAN BASIN. The existing EMS communications in the Permian Basin Region have been developed on a local basis, without state guidelines, and with only minimal regional coordination. This lack of coordination has made it difficult to assess objectively the overall effectiveness of the existing system. However, communications between ambulances and hospitals are nonexistent except in the city of Odessa. In all other areas the medical emergencies are processed on police, sheriff, or fire department channels, and therefore the ambulances are only in contact with these dispatching agencies. Ambulance attendants are unable to consult with a hospital emergency staff on the care of the patient or on selection of the hospital which can best handle the specific type of injury or illness.

Ambulance Communications. There are 22 existing ambulance organizations in the Region, 14 of which are operated by fire and police organizations. For the purpose of dispatching, most of the ambulances have 2-way radios. The majority operate on the common-usage public

safety frequency 37.180 MHz. Others operate on VHF high-band police frequencies. Only Odessa operates its ambulances on a medically authorized frequency of 155.220 MHz. The counties of Borden, Glasscock, and Loving have no ambulance service.

Hospital Communications. Only 4 out of 24 hospitals in the Region have 2-way radios; namely, Community General Hospital in Andrews, Memorial Hospital in Ft. Stockton, Medical Center Hospital in Odessa, and Memorial Hospital in Midland. The Andrews, Ft. Stockton, and Midland hospitals use their radio for paging only. (On a statewide basis, there are 120 hospitals out of 550 that have VHF high-band radios. Seventy-nine of these are fitted with a digital dialing selective address system.)

Regional Center Communications. The city of Odessa in Ector County has been progressive in establishing an effective EMS System. The 911 emergency number is available to a coordinated dispatch point in the fire department. Three federal standard ambulances, each with two EMT-A's, are operating on a medical channel (155.220 MHz) to the primary trauma center, Medical Center Hospital. Installation of a bio-medical telemetry system in the UHF band has recently been completed. A new 500-foot antenna tower is also being installed for VHF and UHF medical transmissions. The city has a communications supervisor who is responsible for integrating the radio services.

911 Telephone Communications. An existing 911 system is available in the city of Lamesa (Dawson County) as well as Odessa. Midland (Midland County) has made advanced plans for 911 installation. The Permian Basin 17-county Region has 50 telephone exchanges operated by 10 different telephone companies: Southwestern Bell, General Telephone, Continental Telephone, Wes-Tex Telephone Co-op, Poca-Lambro Rural Telephone Co-op, O'Donnell Telephone, Romaine Telephone, Coahoma Telephone, Big Bend Telephone, and Sheffield Telephone. Since 9 of these companies are independent from AT&T, the technical capability of their central office equipment to provide 911 service is presently under review. Letters have been submitted to these companies soliciting their support.

General Regional Status. The implementation of an efficient communications system based on a regionally coordinated plan is needed in order to bring the injured or ill person and the appropriate medical care together in the shortest period of time. Reduction in response time is directly related to saving lives and reducing the severity of injuries and suffering. Fortunately, the Permian Basin area is in an advantageous position to develop an excellent EMS System. The area is formally defined into a 17-county region, having a "council of government" planning commission. Therefore, the EMS response area (hospital or emergency care flow area) has formal geographical boundaries. The Region has no exclusive EMS communications system, and therefore a regional system can be implemented from the beginning using a compatible radio network. The planning commission is a progressive group of officials which have the organizational influence to promote regional cooperation. Joint power (jurisdictional) agreements across county

lines can be obtained via this commission. Due to the substantial oil industry within the area, the various counties have the financial resources to follow through on system operations. The largest city, Odessa, is advantageously located in the center of the Region and has an optimum location from the standpoint of central communications and central ambulance transport.

ESSENTIAL COMMUNICATIONS FUNCTIONS. To reach a basic understanding of EMS communications requirements, it is necessary to identify the various functions that must be performed and the various groups that are involved.

1. Detection and Reporting - The process by which a medical emergency is discovered and reported. The citizen should be provided a capability for adequate and timely reporting of an emergency situation. The 911 emergency telephone number system now under development is intended to greatly improve telephone reporting capability.
2. Reaction - The time expended from the receipt at a public safety agency of a request for assistance until the call is processed to a dispatch point and the dispatch is made.
3. Dispatch - The process that initiates and controls the movement of ambulances, rescue services, professional personnel, and supplies to the scene of the emergency. Dispatch may generate from a central dispatch facility or a single public safety agency, depending upon reporting methods or procedures.
4. Response - The time measured from dispatch to arrival at the scene. Although discovery and reporting time are a part of total response, the data on these two factors are not included in response time, but rather are collected separately for appropriate analysis and recommendation for improvement of the public access portion of the communications system.
5. Stabilization - The process of stabilizing the condition of the patient prior to transport to the medical care facility. Voice and telemetry communications are used to provide advice to EMT personnel at the scene of the emergency.
6. Delivery - The transport of the patient from the scene to the proper medical facility. Communications are required to alert the emergency department of expected arrival time and condition of patient and to assist in the assignment of patient to the appropriate medical facility (patient-care vectoring). Communications allow the ambulance attendants and the emergency care facility personnel to communicate directly by telemetry and voice during the transit period.
7. Care Coordination - The process of ensuring overall liaison among all medical care elements. Care coordination consists of three specific functions:
 - a. Intra-facility communications to link all the necessary elements within the operation of a specific hospital, e.g..

hospital to emergency care vehicles, hospital to on-call medical staff, hospital internal paging, and public address.

- b. Intra-area communications to inter-connect several hospitals within a specified local area to determine their bed availability, service capability, and status of supplies.
- c. Inter-area communications to provide the capability for hospitals in one area to communicate with hospitals in other areas.

Each specific function of care coordination is required for a portion of or all of the total EMS. Intra-facility communications are necessary for each single incident, and intra-area and inter-area communications are needed for disaster operations.

- 8. Total Public Safety Coordination - The coordination through appropriate communications of all the activities of public safety agencies (fire, police, rescue, traffic control, etc.) involved in the delivery of EMS.

COMMUNICATIONS PLANNING. The planning of an EMS communications system should proceed along definable standards. Tradeoff evaluations among various design schemes should be based on the degree to which each design concept meets the established set of guidelines. Communications standards have been developed for the following EMS-associated entities: (Refer to Appendix A)

- 1. Single-entry public access emergency telephone number
- 2. Resource coordination center
- 3. Emergency medical care vehicle to hospital communications
- 4. Hospital-to-hospital communications
- 5. Hospital emergency care facility and medical staff communications
- 6. Mutual aid coordination with other public safety groups
- 7. Radio channel allocations, including FCC rules and regulations
- 8. Equipment standards
- 9. Personnel training
- 10. Disaster planning
- 11. Organization elements and manpower resources
- 12. Financial resources and priority allotments

COMMUNICATIONS FACTORS ORIENTED SPECIFICALLY TO PERMIAN BASIN. From a review of Appendix A on EMS communications standards, it is evident that regional system design cannot be optimally formulated without considerable insight into many influencing factors that can only be understood by knowing the detailed characteristics of the particular region.

Medical Emergency Incidence Rates. One basic factor is the incidence rate of medical emergencies in each area within the Region. This

information has been compiled for the Permian Basin by obtaining survey questionnaire data from each ambulance organization. For the higher populated areas where accurate records are kept, the incidence rate has been found to be about one medical emergency call per day for each 12,000 population. This rate is similar to rates found in other regional areas. In the Odessa area, cardiac cases are found in about 12 percent of the total emergencies (average of one heart attack call per day).

Future Emergency Rates, a Function of Population Growth. Radio system plans should consider future needs (additional radio traffic congestion) as well as existing conditions. Radio equipment life of 10-15 years can be anticipated and, therefore, present system planning should attempt to estimate needs until 1990. The estimated regional population growth from 1975 to 1990 is from 338,000 to 435,000 (30 percent) and principally in the major city areas (Odessa, Midland, Big Spring). The graph shown below estimates the average daily emergency ambulance calls in 1975 and in 1990.

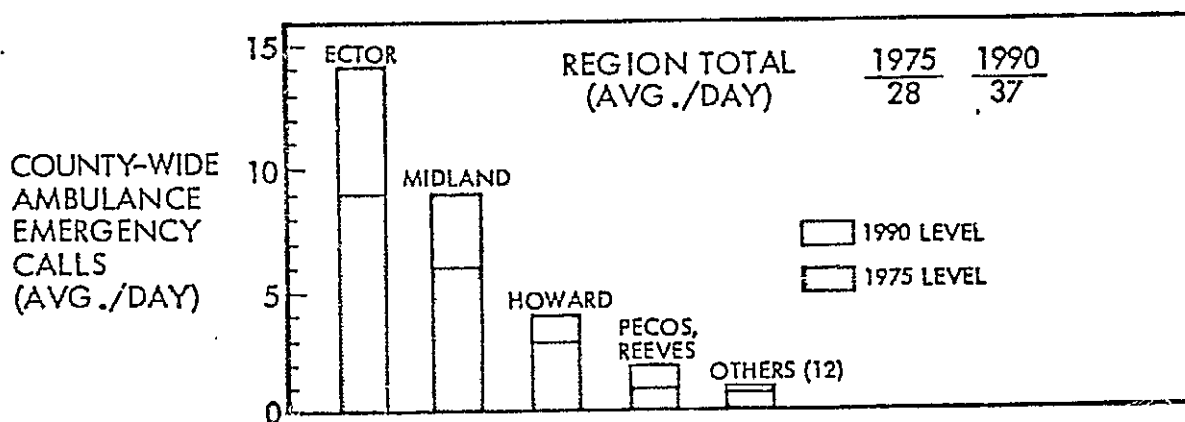


FIGURE 1

EMS Radio Time Requirements. The incidence rates shown above have a direct effect on the radio time needed to support EMS services. Surprisingly enough, only about one minute of voice radio time (dispatch + medical) is needed for an average ambulance run. This time could be more in countywide ambulance calls that require the dispatcher to give geographical details in directing the ambulance to some remote location. It has been found that well-trained EMT's generally know what first aid treatment to make without consultation with hospital medical staff. Primary exceptions to this are in poison cases, where an emetic cannot be given without medical approval and, in cardiac cases, where defibrillation, IV injection, drug administration, etc. cannot be given without medical authorization. For biomedical telemetry radio systems, the air time goes up substantially for a heart attack patient since ECG transmission is generally continuous until the patient is delivered to

the hospital. Additional EMT-physician voice contact is also required for detailed consultation and medical direction.

It can be seen by multiplying the emergency incidence rates by one minute of radio time that the emergency medical air traffic will be relatively low in 1975 and also in 1990. Design attention is therefore not particularly needed in traffic congestion solutions as would be necessary in large metropolitan areas. This is especially true when you consider that ambulance dispatching is generally done on a radio channel separate from the EMT-hospital medical channel.

Existing Radio Systems. To ensure maximum use of existing radio facilities and personnel and to ensure proper medical radio frequency allocations, it was necessary to survey the present radio systems in the Permian Basin Region. This survey included such things as station location, transmitter frequencies, geographical radio coverage area, dispatching agencies, duty hours, jurisdictional areas, etc.

SERS Radio Stations. The FCC "Special Emergency Radio Service" (SERS) covers the radio frequency allocations for medical emergency usage. The SERS service is available for medical services, rescue organizations, veterinarians, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, and communications standby facilities. However, it was found that the Permian Basin has only 5 SERS stations (4 VHF and 1 UHF), all of which are medical service licensees (hospitals in Andrews, Seminole, Midland, and Odessa). Therefore, the new regional EMS system will not have difficulty in obtaining frequency assignments.

Criminal Justice Commission (CJC) Regional Radio System. A new high-band VHF radio network for law enforcement was completed in 1974 and covers the entire Permian Basin Region. Figures 8, 9, and 12 show the basic configuration of this network. A base station is located in each county seat and has, in general, control consoles located in both the Sheriff's Office and the Police Department. Typical channel allocations are as follows:

- Channel 1 County Sheriff Frequency (Duplex frequency pair different for each county)
- 2 County Seat Police Department Frequency
- 3 Mobile-Mobile All Call Frequency (regional and statewide)
- 4 Intercity Frequency (regional and statewide)

Fire Department Radio System. The majority of fire departments still operate on the low-band VHF radio frequency of 37.180 MHz. Only Midland and Odessa (154.430 MHz) and Lamesa (154.250 MHz) operate on high-band VHF.

Distribution of Medical Facilities and Services. The communications design must link all of the counties into the medical system regardless of the medical facility distribution. This is a major design problem for rural areas. In the Permian Basin four counties have two or more hospitals in the county seat, nine counties have only one hospital, and

four counties have none. Five counties have only category IV hospitals (physician and anesthesiologist not on duty 24 hours a day). Three counties have no physicians, and seven others have four or fewer physicians. Three counties (those without hospitals) have no ambulance service.

Geographical Characteristics. Communications design must specifically be oriented to the regional size and terrain features in order to determine radio station location requirements, antenna site locations, antenna heights, transmitter power levels, etc. The Permian Basin Region is extremely large, having an area of 24,000 square miles, which makes it half the size of Illinois, twice the size of Massachusetts, etc. The area is relatively flat except for the furthest southwestern area and a small "mountainous area" between the towns of Rankin, McCamey, and Crane.

Flatness has both advantages and disadvantages from a communications viewpoint. Radio antennas must be higher and located closer together in a flat area, but fewer radio "dead spots" are found than in a hilly or mountainous area where antennas must be located on top of the highest terrain feature to maximize line-of-sight coverage. Mountain-top antennas have much greater range and are ideal for effective repeater operation. (New Mexico's EMS UHF radio network covers the entire state by use of 22 mountain-top repeaters.)

Odessa, the largest city, is located in the center of the Permian Basin Region, and, with its 500-foot antenna tower, this city is geographically ideal for locating the Regional RCC and the Regional MCC.

Resource Coordination Centers (RCC). The previous section's description of the CJC radio network indicates that this radio network and county seat dispatching centers are ideally suited for becoming RCC's. In fact, it was found that these law enforcement agencies were the only county groups that had a dispatcher on duty 24 hours a day. The general situation is that the sheriff's office is manned during the day but night duty dispatching is left to the local police department. The sheriff has a telephone type radio remote unit at his residence for nighttime contingency use. The five counties of Borden, Glasscock, Loving, Martin, and Terrell have no police departments, and therefore nighttime contact/dispatching is only from the sheriff's residence.

Medical Control Centers (MCC). The previous section's description of the Permian Basin medical facilities indicates that the locational choice of the county Medical Control Center is generally limited to one or two hospitals in the county seat. The shortage of physicians also indicates that wide-area radio paging and radio-telephone patching will be necessary in many counties.

COMMUNICATIONS SYSTEM STUDIES AND TRADEOFFS. An appreciable effort was made to survey existing EMS communications systems to determine the various techniques utilized as well as any problems that were being experienced. A survey was made of EMS systems in New Mexico, Nebraska, Idaho, Arkansas, Kentucky, Illinois, Florida, Mississippi, Louisiana, Maryland, and Minnesota. Houston has an advanced EMS system which was observed directly in operation. The "good ideas" learned from these surveys have been factored into the "Communications Standards" section

and the "Proposed Communications Network" section.

New EMS System or Tie-in With Existing Public Safety System. An initial effort was made to determine the possibility of making EMS communications an adjunct to the existing CJC regional radio network. Telephone-type radio remote control units could be placed in the county seat hospitals and would be capable of communications over the CJC radio network (but still under the control of the law enforcement dispatcher). FCC regulations allow this type of operation (FCC 899) [FCC 39.307 (b)] and obviously the cost would be very small for the hospitals. New radios would still need to be added to the ambulances. Since 14 out of the 22 ambulance organizations are operated by fire and law enforcement groups, this plan had certain merit.

However, this system approach soon ran into resistance by certain law enforcement and medical related groups. The law enforcement group felt that emergency medical needs would present problems with radio usage priorities, and more emphatically they felt that private personnel not under their control (hospital staff, ambulance drivers, etc.) could possibly misuse the law radio channels (improper protocols, paging requirements, lengthy conversations, non-emergency usage, etc.) The medical group felt that medical communications would always be a step-child to law enforcement, and that system flexibility and innovations would be hindered. In addition, the state plan, although non-directive, is for exclusive medical radios on hospital premises and has been implemented in 131 hospitals.

UHF Versus VHF. The second effort was to determine the tradeoffs of an EMS exclusive UHF versus VHF system, especially in consideration of EMS future operational requirements, e.g., more radio traffic, biomedical telemetry advanced life support, etc. VHF has advantages of greater range and less attenuation from fog or foliage, and less equipment cost. UHF has range about 20 percent less than VHF, penetrates buildings better but fog or foliage less. VHF at present time tends to be more crowded than UHF since the latter has more available channels. In the SERS service, there are 18 high-band VHF channels available versus 24 in the UHF band. All of the UHF channels are for exclusive medical use (specific limitations however) while only 6 VHF frequencies are exclusively for medical usage. VHF has paging frequencies, while UHF has none. However, only UHF can be used for biomedical telemetry. VHF has simplex usage; UHF is duplex.

The cost difference is substantial between a basic life support VHF system and an advanced life support UHF system. A minimum VHF system costs about \$8,500 for a base station, antenna tower, and two mobiles. An advanced UHF system costs at least \$32,000 for a base station, antenna tower, two mobiles, and two portable biomedical telemetry packages (including defibrillator, ECG, cardioscope, telephone coupler, chart recorder, and blood pressure monitor). The 4 to 1 cost factor is significant, especially if implemented on region-wide basis.

Another significant consideration in rural areas is the requirement for medical paging and dispatching. UHF cannot be used for paging, and the UHF cost given above does not include a separate UHF dispatching capability.

FCC Rulings Affecting VHF and UHF Medical Operations. The basic requirements have been published in the Federal Register, Vol. 39, No. 137, July 16, 1974. Amendments have been made via FCC 74-1156, dated December 6, 1974, and FCC 74-1388, dated January 31, 1975.

A revision to Docket No. 19880, adopted October 22, 1974, clarifies UHF equipment requirements for UHF operation. Basically, the ruling states that:

- (a) Paging is not allowed on UHF frequencies, and separate equipment for this function will be necessary.
- (b) Dispatching on the same frequencies and equipment that are utilized for medical instruction or biomedical telemetry is recognized as a potential problem for some users that may require solution by using different equipment where dispatching does not have secondary priority.
- (c) Mobile units must have full 8-channel capability (463/468 pairs), wired and "crystalled".
- (d) Portable units (hand-held) are exempted from the multi-channel requirements if not more than 2.5 watts maximum.
- (e) Base and control stations must have three channel pairs minimum or four channel pairs minimum when biomedical telemetry is employed. (May be implemented in single or multiple equipment assemblies.) Simultaneous operation is not required on multiple channel pairs.

FCC Docket No. 19523, adopted December 17, 1974, opens up VHF usage. It deleted the "developmental" limitation and reducing coordination requirements from 75 miles to only 35 miles.

VHF System Design Tradeoffs. The FCC regulations limit the number of SERS channels typically as follows:

- Frequency 1 Local Area Medical Voice (choice between 12 frequencies)
- 2 Paging, 1-way voice (choice between 3 frequencies)
- 3 Portable unit voice to ambulance repeater (choice between 2 frequencies)
- 4 Mutual assistance/Inter-area voice (155.340 MHz)

Fortunately for the Permian Basin, the channel limitation is not a problem due to the low emergency incidence rates. Therefore, the advantage of more channels in the UHF band does not have special meaning for the rural Permian Basin Region. VHF channels will be adequate in 1975 and in 1990. VHF has 20 percent better range. VHF is presently installed in 131 Texas hospitals and is the basic system of choice by State planners. VHF is used in the CJC regional network and can be interfaced easily by a VHF EMS system. The VHF CJC channels are the logical ones for use for ambulance dispatching from the RCC (law enforcement 24-hour dispatch office). VHF equipment is cheaper. However, VHF cannot be used for biomedical telemetry.

UHF Biomedical Telemetry. Biomedical telemetry transmits ECG data from a heart-attack patient to the hospital in order for the EMT to receive medical instructions concerning expeditious treatment to stabilize the patient's condition. Several implementation problems have been found; namely, which areas should have this capability, whether the portable radio should be an integral part of an integrated medical package, and how to interface with Odessa's existing frequencies. The first problem is involved with EMT training and subsequent opportunity to maintain proficiency by actual use of acquired skills. Discussions with several physicians who are directly involved in EMT training indicate that proficiency in starting intravenous injections cannot be readily maintained unless an average of at least one IV is started each day. Intravenous injections are especially difficult to start if the circulatory system has collapsed. A review of the Permian Basin's incidence rates indicates that Odessa may have an average of one heart attack call a day, Midland one every two days, and Big Spring one every three days. Other towns would have incidence rates less than one call every eight days. The installation of biomedical telemetry is therefore very dependent on EMT's getting on-going experience via hospital emergency room work, IV-training mannequin, etc.

Biomedical telemetry has been found useful on cases other than heart attack. A New York region's experience showed that five percent of the trauma patients (non-heart attack) had ventricular fibrillation as a secondary effect. Houston's experience (20 cardiac-related calls per day) shows that their ECG monitoring equipment is used at a rate almost three times that of their primary heart attack calls. Serious trauma victims are ECG monitored so that immediate action can be taken if incipient ventricular fibrillation appears. Some cardiac arrests can be prevented in this way. (Use of a siren increases the patient's heart rate and should be minimized.)

Some EMS groups prefer a separate radio unit for ECG transmission rather than being integrated into a medical resuscitation package. The radio, if separate, can be used as a general purpose portable for on-the-spot voice transmissions. The decision on this point can await post-proposal detailed design and should perhaps be by the particular ambulance service EMT group after evaluation of the several commercial packages which are now available.

Portable ECG monitoring devices should have the capability for acoustic coupling using a standard dial-up telephone. This technique provides a backup to the radio and also can be used to transmit ECG signals to a distant hospital which has a coronary care staff. ECG transmission capability via telephone lines should also be considered from limited facility hospitals to another hospital having a coronary care staff.

Selective Station Addressing. Station addressing is frequently utilized when there are multiple radio users on the same frequency. Transmissions are preceded by a specific coded tone which enables only a selected location to receive the message. For EMS systems, the usual approach is for the ambulance to transmit a fixed tone or a series of tones to the selected hospital receiver. If the hospital tone decoder finds the tone code to be correct, it allows the receiver

audio to get through to the speaker. Hospital-to-hospital transmissions are also preceded by a selective station tone code. This technique keeps unwanted messages ("botherance") from being heard on station speakers. Without this feature, the speaker volume is usually turned down and wanted messages are now susceptible to going unheeded.

The techniques of tone coding are basically of three types. The first is continuous transmission of a particular fixed frequency tone below the audio bandwidth, e.g., 88.5 Hz, which will be decoded by only the selected reception location(s). The second technique is one time transmission of a numeral sequence of tone pulses of a fixed frequency, e.g. 1500 Hz. The third technique is one time transmission of a sequence of tones of different frequencies. The first technique is referred to as continuous tone coded squelch system (CTCSS); the second and third as digital dialing. The third technique is the specific type of dialing known as "Touch Tone" or dual tone multiple frequency (DTMF). An evaluation of each technique was made to determine whether one was preferable for EMS operations. Illinois has both the coded tone squelch system (different tone for each hospital plus an all-call tone) and the digital dialing system fixed tone frequency. They are discontinuing the digital dialing system since the 7-digit dialing sequence was too time-consuming and was subject to misdialing. The Illinois ambulances have a selectable tone generator with eight push button tones. Six tones are for the six hospitals that the ambulance frequents; one tone is an all-call tone useable for any hospital; and one tone is for the state police stations. The only disadvantage to this scheme is that all-call must be used if going into a hospital not on one of the six available tones.

Mississippi uses digital dialing exclusively but with only three digits. They report occasional receiver "falsing" from a neighboring state which has 7-digit dialing. They recommend a 4-digit number.

Texas hospitals generally have been using the digital dialing system (dialed numerical sequence of 1500 Hz tone pulses). Seventy-nine hospitals have this system, 35 of which are in the Houston area. Most use a 7-digit number, although a few do use a 4-digit code. The State EMS communications planner has indicated that a better system for future operations would be the DTMF ("Touch Tone") type of digital dialing. This type is already being used in the Criminal Justice Commission (CJC) radio network for intercity selective addressing. Major referral hospitals would have station decoders for both types of digital dialing to ensure compatibility with all incoming ambulances.

911 Telephone System. A substantial effort has been made to understand the various factors involved in 911 system implementation. Detailed reference material was studied; namely, "911, A Handbook for Community Planning", available from U.S. Printing Office, "National Survey of Statewide 911 Activity" published by Franklin Institute Research Laboratories, "911 in Florida, A System Concept" published by Stanford Research Institute (SRI), and "Florida 911 Interim Planning Guide" published by Division of Communications, Florida Department of General Services. In addition, a survey was made of the Omaha, Nebraska, 911 system, as well as all the 911 towns in Texas; namely, Alice, Galveston, Hearne, Huntsville, Odessa, Quanah, Victoria, College Station.

Irving, Lamesa, Sherman, and Commerce. Information was gathered on the call volume, percent of non-emergency calls, percent of calls by emergency type (police, fire, medical), type of telephone equipment, telephone connections with other agencies, 911 options utilized, installation/leasing costs, special problems, etc.

It was noted in the 911 reference material review that Florida and California have enacted laws requiring 911 implementation. The New York State Public Service Commission has also placed a special regulatory policy on 911 service provisioning to "existing emergency reporting centers". Both New York State and Nebraska presently have more than 50 percent of their population served by a 911 system. Texas is the only state that does not have a public utility regulatory commission. It is not known whether this factor will make regional implementation of a 911 system in the Permian Basin more difficult.

The SRI report referenced above states that a reduction in emergency reporting time from 1.5 to 4 minutes can be anticipated with the advent of 911 service. For the State of Florida, the SRI analysis shows that the reduced response time will lower fire losses to the extent that reduction in both insurance premiums and uninsured losses will completely offset the additional telephone cost of 911 service. With this point of view, the "intangible benefits" gained in the law enforcement and emergency medical areas are in essence obtained free.

The SRI report indicates a rule-of-thumb volume and division of 911 call types as shown below (in comparison with Odessa rates).

TABLE I. - 911 CALL VOLUME

	<u>SRI Report</u>	<u>Odessa</u>
Total calls/day/1,000 pop. (low crime area)	1.75	0.87
Non-Emergency Calls	not reported	47%
Law Enforcement Calls	85%	40%
Fire Department Calls	9%	6%
Ambulance Service	6%	8%

If you assume that most of the Odessa non-emergency calls are police related, then the SRI/Odessa call percentage comparison is similar. The big difference is in the total call volume factor of 1.75 as compared with 0.87 for Odessa. From smaller 911 towns in Texas, the factor gets as low as 0.5/day/1,000 population. Due to the very small 911 traffic (less than 1.5 "busy-hour" calls) in all Permian Basin county seats except for Odessa, Midland, and Big Spring, a single 911 line from the local central office to the RCC would probably suffice: (1.5 calls X 45 secs./call = 0.68 hundred call-secs.)

1.5 busy-hour calls (15% of daily call total)
X 45 secs. (average holding time)

0.68 "hundred call seconds" in busy-hour period

Therefore, for "P.O1 service" (one "busy-back" in not less than 100 calls), only one 911 lines is needed (refer to trunk capacity tables). The telephone company (as well as the Florida State Plan) recommends a minimum of two 911 lines for each central office. This difference can be worked out during regional detailed 911 planning.

Information has been gathered showing the telephone exchange locations and the various companies found in the Permian Basin. There are 50 central offices and ten different telephone companies. The study of 911 system implementation has shown that problems of a technical, scheduling, cost and political nature can be anticipated. These problems are discussed below.

911 Technical Problem. Present central office equipment used by the telephone companies may not be capable of 911 service without considerable modification. Contact has been made with business office representatives of Southwestern Bell Telephone, General Telephone, Continental Telephone, Wes-Tex Telephone Co-op, and Poca-Lambro Telephone Co-op. These companies serve the 17 county seats in the Permian Basin Region.

Southwestern Bell and General Telephone have a general policy of providing the basic 911 service without making a direct charge for central office modifications. Therefore, we need not be particularly concerned with the technical difficulties in their exchanges. However, discussions with the other three companies have revealed that their policies are determined at the local level. Due to the small size of their exchanges, the central office equipment generally has limited capability. Preliminary rough estimates show that modification costs will generally be around \$1,000-\$2,000 but certain central offices may cost as high as \$10,000. These costs must be paid at the time of installation.

Certain of the auxiliary 911 features (hold-line-open, re-ring, forceable disconnect, public telephone dial-tone-first) are generally not available without considerable installation expense. The hold-line-open option should be seriously considered in those areas that have a history of false alarms or pranksterism. Calls can be traced with this feature.

Jurisdictional boundaries of telephone exchanges do not always coincide with political boundaries. For example, Barstow in Ward County is in a part of the Pecos exchange in Reeves County. Certain Odessa/Ector County subscribers are connected to the air terminal central office in Midland County. In these cases, a 911 emergency in one county is answered in another county. For a regionally coordinated system, jurisdictional agreements can resolve problems of this type.

911 Cost Problem. Major central office modification costs are discussed above. Another cost problem arises when long distance trunk lines are required to connect one exchange with another. To connect all the population in each county to the county seat RCC via 911 would involve about 600 miles of Permian Basin trunk lines. The long distance trunk rate in Texas is \$3/mile/month; therefore, the total cost would be about \$18,000 per year. The cost factor per emergency call would not be reasonable considering the very low emergency incidence rates outside the county seats.

The Omaha, Nebraska, area (600,000 population) has 911 service in two counties and a small portion of a third county. This service has about 70 local trunk lines at a cost of \$6,000/month (\$72,000/year). Obviously, telephone lines on a regional basis can be very costly. Illinois uses dedicated lines for intercom and radio remote control between regional medical centers and local hospitals. Their phone bill for this service is \$96,000/year.

Cost figures can be misleading unless they are related to a common denominator. Cost per 911 call is a good way to relate one system with another. The Omaha 911 center receives about 22,500 calls a month. Since their 911 telephone bill is \$6,000 per month, the cost per emergency call is \$0.27. The cost factor increases for smaller population areas. Long "dedicated" 911 trunk lines from outlying towns into the county seat cannot be cost-justified due to the low traffic. However, "tandeming" arrangements may be feasible. Southwestern Bell Telephone policy is not to charge for any 911 calls routed on existing tandem trunk groups.

If a 911 system is installed only in the county areas where the expense of long trunk lines is avoided, it may be feasible to cover about 90 percent of the Permian Basin population. The other 10 percent could have available a direct tie-in with the county seat RCC by use of another telephone number. This is discussed in a following paragraph, "Alternate Public Access Telephone Systems".

The cost of local 911 systems can be made reasonable if various telephone configurations are studied so that cost tradeoffs can be made. Figure 14 provides information on typical configurations and costs. It should be noted that the 911 system is intended to reduce the emergency "reporting time". However, as a consequence of having a single answering point, other direct lines are needed from the RCC to police, sheriff, fire, ambulance, MCC, etc., so that the emergency "reaction time" is minimized. Some of these direct lines may already exist, but others (to ambulance company, to MCC) may have to be added. Therefore, the 911 system approach does entail associated telephone cost which is more than just the incoming 911 line(s). To lessen the cost impact, an effort should be made to eliminate any existing telephone services and to consolidate others.

911 Political Problem. A 911 system is rarely installed from a request by the individual public safety agencies. It has been found that the system results from political action at a higher level, e.g., community, state, or federal. The public safety "reaction time" in the case of fire, police, and sheriff, is perhaps not improved, but the emergency "reporting time" after citizen's detection, should be lessened. More importantly, in the case of medical emergencies, there is no public agency which takes overall responsibility for the patient's proper care. The citizen has no assurance that the ambulance will arrive promptly, that the ambulance attendant will be properly trained, or that the patient will be delivered to the hospital best suited for his care. The advent of the RCC and MCC will hopefully resolve this problem.

The 911 RCC coordinator has the responsibility of screening all calls to determine if they are true emergencies. If not, he directs the caller to the non-emergency telephone number which goes directly to the

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applicable agency. If the call is a police or fire emergency, the coordinator has the option of taking all the necessary information directly or patching the caller directly to the police or fire dispatcher. However, for medical emergencies the RCC must take all the information and be responsible from that point on to ensure that prompt ambulance service is rendered and that the MCC is notified of the potential necessity of giving radio medical consultation, giving appropriate hospital delivery assignment, and giving prompt medical attention upon patient's arrival. The RCC coordinator must document the EMS calls and subsequent response to meet the HEW requirements for operational evaluation.

The involved public agencies must surrender a small part of their autonomy for the public good, and it is this factor which may present a political problem in the community and in the Region. To alleviate this problem, the 911 coordination duties and protocols should be defined by the involved agencies and governmental officials in a spirit of cooperation. The personality of the 911 coordinator should be one which engenders positive relationships even under stressful conditions. Preferably, the coordinator should have EMT training so he can give self-help instructions to the citizen caller and coordinate in a knowledgeable manner with the ambulance EMT at the scene.

911 Scheduling Problem. Determination of telephone circuit requirements must taken first priority due to the long lead time needed by the telephone company to plan and install the necessary lines. Scheduling periods of 15 to 24 months are not uncommon. The telephone company will not begin any formal planning until several actions are taken by the local government. First, it must be demonstrated that public agency agreements have been made to establish a central emergency answering point for police, (sheriff), fire, and ambulance emergencies. Second, a formal letter must be submitted from the local government to the telephone company requesting a proposal for 911 service, and preferably giving the specific number of lines, terminal devices, station locations, special optional features, etc., that are required.

The best approach is to discuss on a semi-formal basis with the telephone company the alternate technical configurations that are possible and the associated cost factors. Representatives from the involved public safety, medical, and engineering planning groups should sit around the table with telephone company officials to review specific technical/cost features of 911 service. Optional services such as caller switch-through, hold, re-ring, forceable disconnect, public telephone dial-tone-first, etc., should be discussed. Terminal device capabilities (switchboards, key sets, call directors, etc.) should be reviewed along with intercom line requirements to ambulance company, hospital, sheriff's office, etc. An estimate should be made of the number of anticipated 911 calls so that the necessity for multiple incoming 911 lines can be determined. Cost options should be analyzed on the basis of estimated cost per actual 911 emergency call.

As a result of the coordination meeting (requirement-finding and cost-finding), the official letter of request to the telephone company can be more specific, thus saving time in the long run. The telephone company then prepares a formal proposal and submits it to the requesting city or county government. That government then decides whether to

authorize the 911 service. After authorization, the telephone company begins its detailed engineering work and installation planning (15 to 24 months). It is evident from the above discussion that telephone requirements should be given first priority. A regional detailed 911 plan should be prepared to give technical/cost guidance to the local county governments.

Alternate Public Access Telephone Systems. If certain areas do not have telephone equipment capable of 911 service, or if dedicated trunk lines are not affordable, then alternate public access should still be available into the RCC.

Inward WATS Service. Wide-area telecommunications service could be made available via a public toll-free 1-800-XXX-XXXX number. However, this service is expensive unless the traffic is high. The unlimited-time monthly rate is \$900; the minimum rate is \$240/month for ten hours of cumulative service and \$22/hour thereafter.

The Northeast Florida EMS Project (eight-county region centered around Jacksonville) uses a WATS number (2 lines) for its county citizens. They have the option of calling their local county EMS center (usually the sheriff's office) or using the toll free WATS line. There are about 150,000 persons in the county areas outside of Jacksonville. The leasing charge for the two WATS lines is \$480/month (20 hour minimum time). The present utilization rate is only 5.6 hours/month. The regional WATS system is technically effective since the Jacksonville center can switch the WATS caller directly through to a dedicated telephone circuit (separate circuit to each of seven counties) routed to the applicable county EMS center (sheriff's office). These dedicated circuits increase the Jacksonville EMS phone bill to \$1,400/month. Cost calculations for the Permian Basin Region show that this type of system (WATS/dedicated station circuits) would not be cost effective.

Enterprise Service. An "Enterprise" telephone service is also available for public toll-free access. The citizen calls the local operator and asks for the "Enterprise Operator". He then asks for "Enterprise number XXX". The operator looks at her listing for XXX and proceeds to call the specific 7-digit number that is referenced. The call is paid "collect" at normal public rates (local calls no charge, long distance calls at time/distance rates). A monthly charge of \$3 is also added to the cumulative "collect" charges. The public has use of the service without charge, but contact with two operators is first required. This system does not seemingly offer any reporting time advantages. Minnesota uses this system however.

Pseudo 911 System. In lieu of a 911 system, a "pseudo 911" system may have merit in certain areas. The advantages of 911 in order of priority are (1) it is easily memorized, (2) it goes to a central emergency agency, and (3) it is applicable on a widespread basis (if not now, then in the future). For those areas where 911 equipment capability is not present or where the cost of trunk lines is prohibitive, then the possibility of a pseudo 911 system should be explored. This system would attempt to approximate the three advantages listed above for the 911 system. A pseudo 911 number going to a central

emergency agency (RCC) is no problem. A proposal can be made that the number, XXX-5411, is an excellent substitute in rural areas where there is only one telephone exchange in the county seat. Everyone in the county seat knows the exchange number, and 5411 is a close equivalent to 911. In fact, within the local exchange area, only the last five digits need to be dialed. In rural counties, it is probable that persons outside the county seat also know its exchange number.

For the Permian Basin Region, the tentative proposal is for 911 systems in all county seats where possible and a XXX-5411 (or other easily memorized) number to the RCC (1) for use by citizens outside the county seat and (2) as a backup to the 911 line in the event of temporary malfunction. The cost of a second 911 line could possibly be eliminated by having the alternate 5411 number in its place. Large towns will need two or more 911 lines. The user of a "call-diverter" should be seriously considered for the small towns where a local coordinator would not be available for 911 calls on a 24-hour basis. In this case, the 911 calls would go to the Resource Coordination Subcenter (RCSC) during the day but be connected to the "call diverter" for nighttime contact with the county seat RCC via the XXX-5411 line. The citizen uses the 911 number at all times, but the "call diverter" automatically transfers the callers to the XXX-5411 line when the local coordinator is not present. This system would also have advantage of toll-free service to the citizen. Call diverters can be purchased for only about \$275 in group quantities.

Automatic Calling Telephone System. There are many telephone numbers that the RCC and MCC may have occasion to use during emergency operations. Contact might be required to medical staff residences, to regional MCC, to other MCC's and hospitals, to special care centers (poison control, coronary, burn, psychiatric, etc.), to blood banks, etc. Many of these contacts might be required via radio-to-telephone patch from ambulance EMT's at the scene or during patient delivery, especially in counties having Category IV hospitals. The use of an inexpensive automatic dialing device (\$3.50/month telephone accessory unit) should be considered. A tray of do-it-yourself pencil punched cards would be made available with the calling destination labeled on each card. The card is inserted into the dialer, and the number is dialed automatically. By pressing another button on the radio patch, the medical radio channel is connected to the telephone line. An EMT in the far reaches of Terrell County could talk to a medical specialist in Odessa.

PROPOSED COMMUNICATIONS NETWORK FOR PERMIAN BASIN. From the preceding discussions, the various system design alternatives and tradeoffs have been dealt with, including cost factors, manpower resources, political factors, etc. System engineering, in its best sense, should deal with all the influencing factors before arriving at a final proposal. It should be emphasized, however, that this is still only a proposal and that more engineering work and detailed coordination at the local level must be performed before the final design pieces all fall into place, allowing procurement specifications to be prepared.

Functional Framework, Resource Management. Figure 2 shows the functional flow paths for communications. Primary resource coordination is done at

a county level (RCC and MCC), but regional RCC and MCC centers are available in Odessa. Initial dispatching is done by direct intercom telephone to the ambulance operator and to the Medical Control Center after receipt of 911 call. (Fire, police, sheriff, DPS, etc., calls are handled likewise to the applicable public agency.) Enroute ambulance dispatching is made from RCC using radio link. EMT contact to MCC is by ambulance radio or by portable radio for the purpose of medical consultation.

The county MCC's will be able to contact the Regional MCC by radio (if within nominal 60-mile line-of-sight range) and/or by automatic telephone dialer. Contact with other hospitals and with the regional special care centers is also by automatic dialer. A radio-phone patching device allows the EMT to talk directly to the above medical facilities. Wide area radio paging will be implemented in those MCC's not having full-time medical emergency staff. A 911 telephone system will be implemented in each county seat area where feasible.

A pseudo 911 system (XXX-5411 or equivalent) will be considered in areas where 911 is not affordable. Advanced life support biomedical telemetry systems will be implemented in Midland and Big Spring (Odessa system already exists), contingent upon further detailed cost and EMT training impact reviews.

Detailed Communications Design, Radio, and Telemetry. The details of the proposed system are shown in Figures 5 through 13 and in Table II. The basic rationale for the selected design features have been discussed in previous paragraphs. The proposed system is capable of meeting almost all of the requirements given in Appendix A "Communications Standards". The system is considered compatible with the State guidelines and with those of HEW.

Maximum utilization of existing facilities and manpower will be accomplished by using the police, sheriff, or fire departments as the RCC. The regional CJC radio network will be used for ambulance dispatch from the RCC and for mutual aid coordination with all public safety groups. A separate VHF base station will be installed in the Medical Control Center hospitals for exclusive medical use between the EMT and the hospital staff (155.340 MHz). Wide area medical paging (152.0075 MHz) will be implemented in those hospitals not having full-time medical staff. Biomedical telemetry systems on the FCC standardized UHF channel pairs will be implemented in Midland and Big Spring (third and fourth year funding) to complement the existing UHF system in Odessa. Continuous tone coded squelch (CTCSS) will be used in ambulance-to-local MCC communications (no dialing required). Ambulance communications to other referral hospitals and MCC-to-MCC communications will utilize DTMF ("Touch-Tone") digital dialing (three digits). A citizen's band radio monitor on emergency channel 9 will be installed at each RCC.

The three counties of Borden, Glasscock, and Loving have no hospital and therefore no local MCC. In most cases, the emergency care vehicle will be within 155.340 MHz radio range of the adjacent county MCC. However, if the radio link is marginal, use of the CJC dispatch link can be used for mutual aid. The radio-telephone patch at the RCC can connect the EMT with medical personnel for this backup mode of operation.

After the radio supplier is selected, a regionally coordinated effort will be necessary to give tone assignments to the medical pagers since all pagers will be receiving on the same 152.0075 MHz frequency. The three hospital radios presently on the wrong frequency for paging should be converted to 152.0075 MHz.

In addition to the ambulance organizations in the county seats (all of which have high-band VHF), there are seven other existing ambulances, mostly in smaller towns of less than 1,000 population. Six of these are operated by volunteer fire department personnel. These units will have existing low-band VHF radios (37.180 MHz) as a minimum, and consideration (funding limitations) will be given to replacing these with high-band units. Low-band communications can make contact with medical personnel by means of the radio-phone patch at the RCC.

The primary design unknown at the present time is the practical feasibility of a complete regional 911 telephone service from a technical need/cost squeeze basis. Jurisdictional maps showing telephone exchange boundaries as compared to political boundaries must be obtained. The feasibility of low cost tandem trunking schemes must be explored with the ten telephone companies. Additional consideration must be given to effectiveness of adopting a pseudo 911 number as an interim approach. The resolution of 911 implementation problems will be given first priority after grant award.

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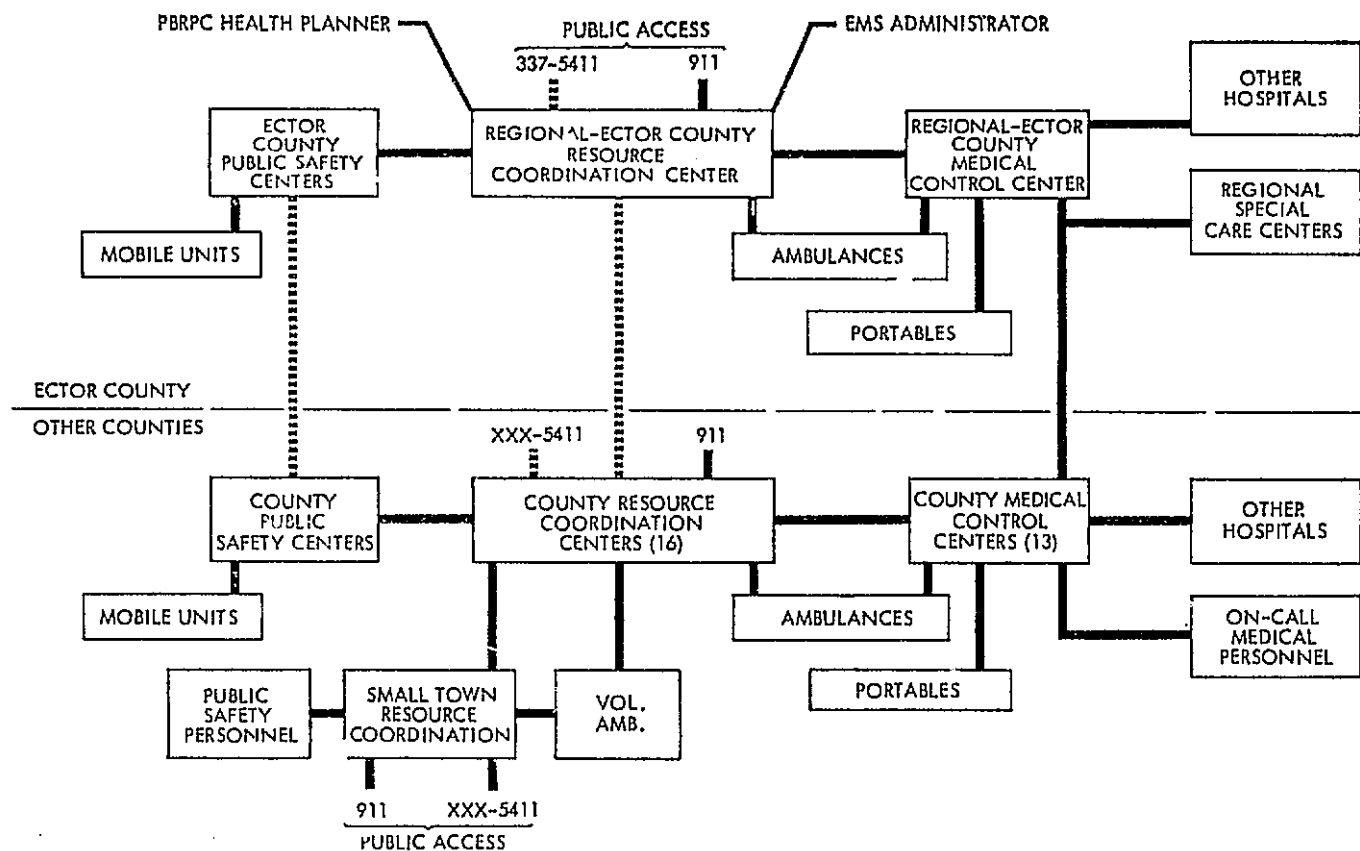


FIGURE 2. - FUNCTIONAL FRAMEWORK - RESOURCE MANAGEMENT

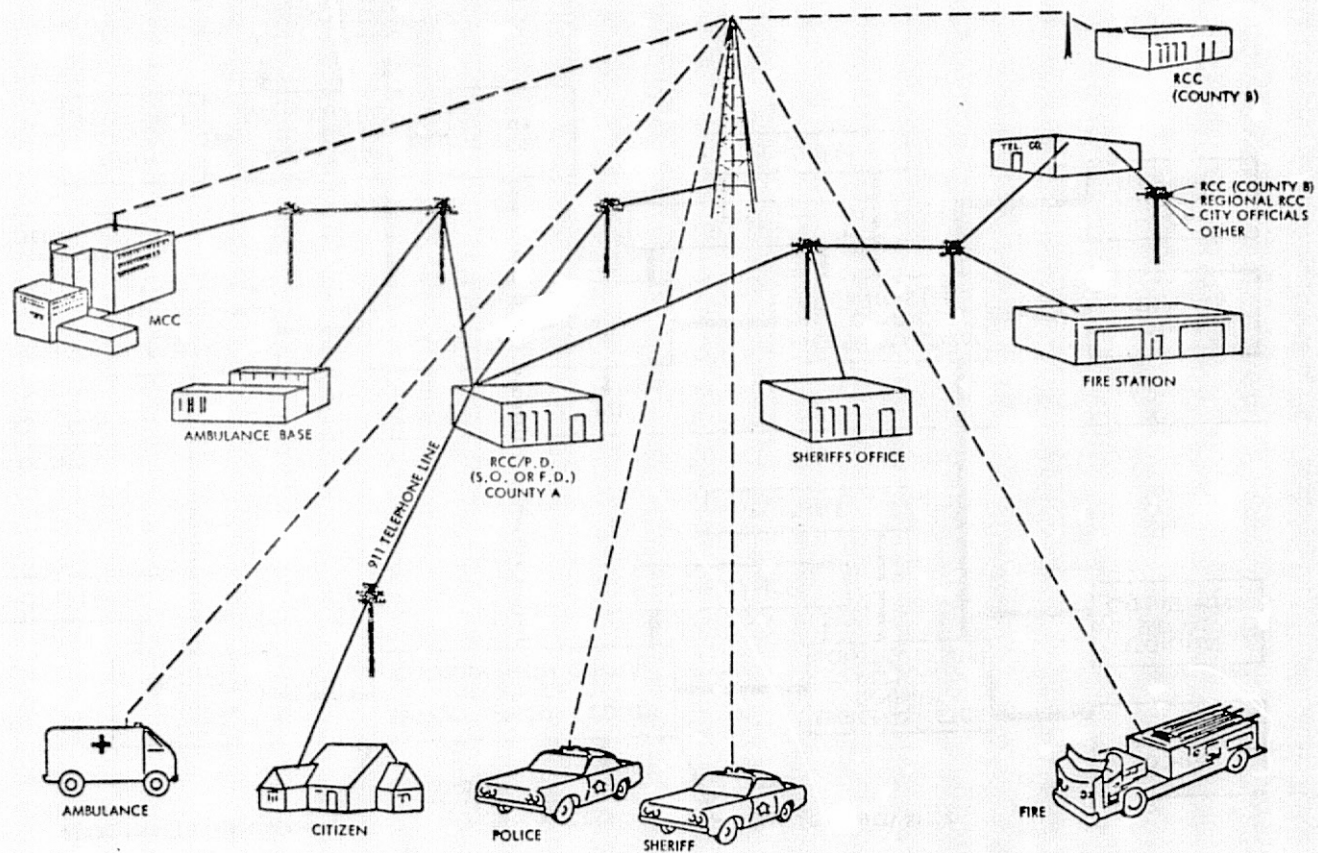


FIGURE 3 - RESOURCE COORDINATION CONTROL

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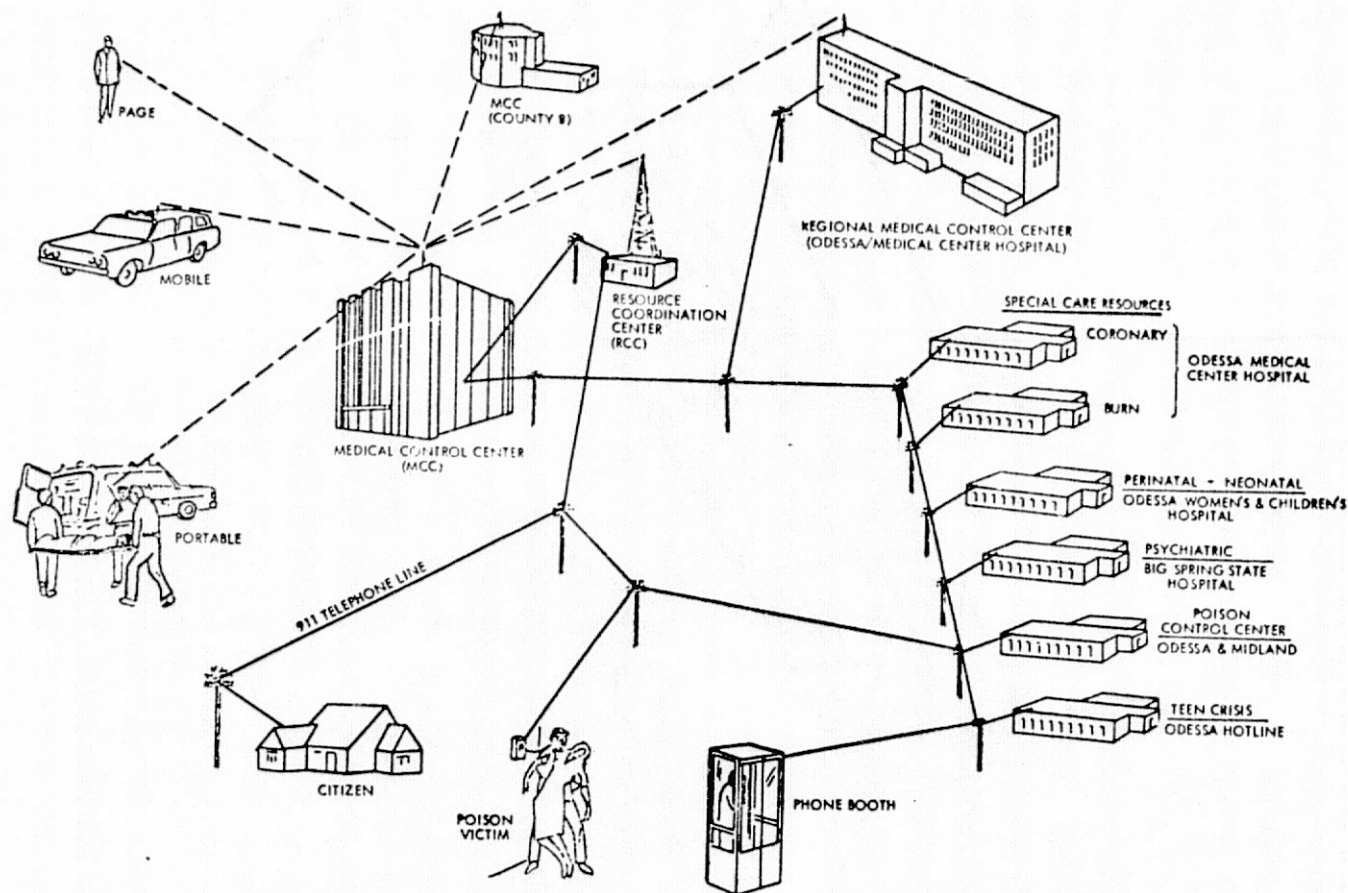


FIGURE 4. - MEDICAL CONTROL

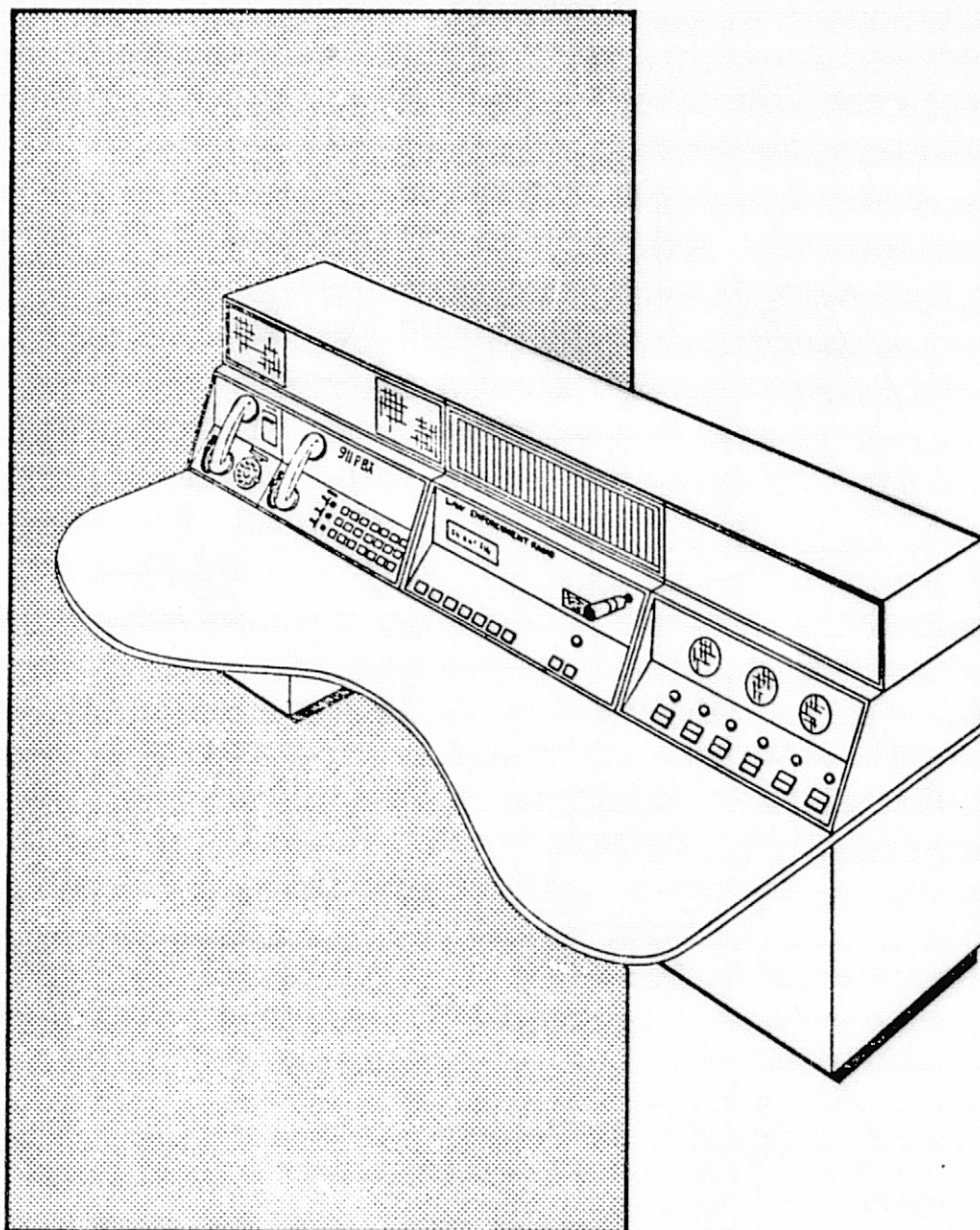


FIGURE 5. - COMMUNICATIONS CONSOLE - RESOURCE COORDINATION CENTER

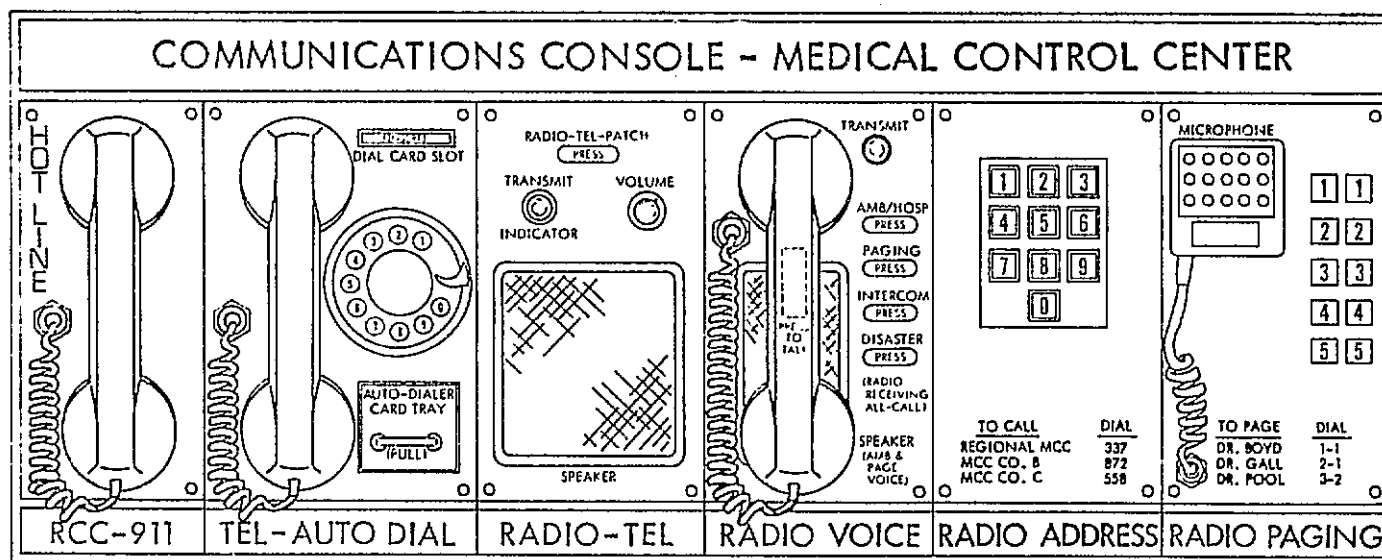
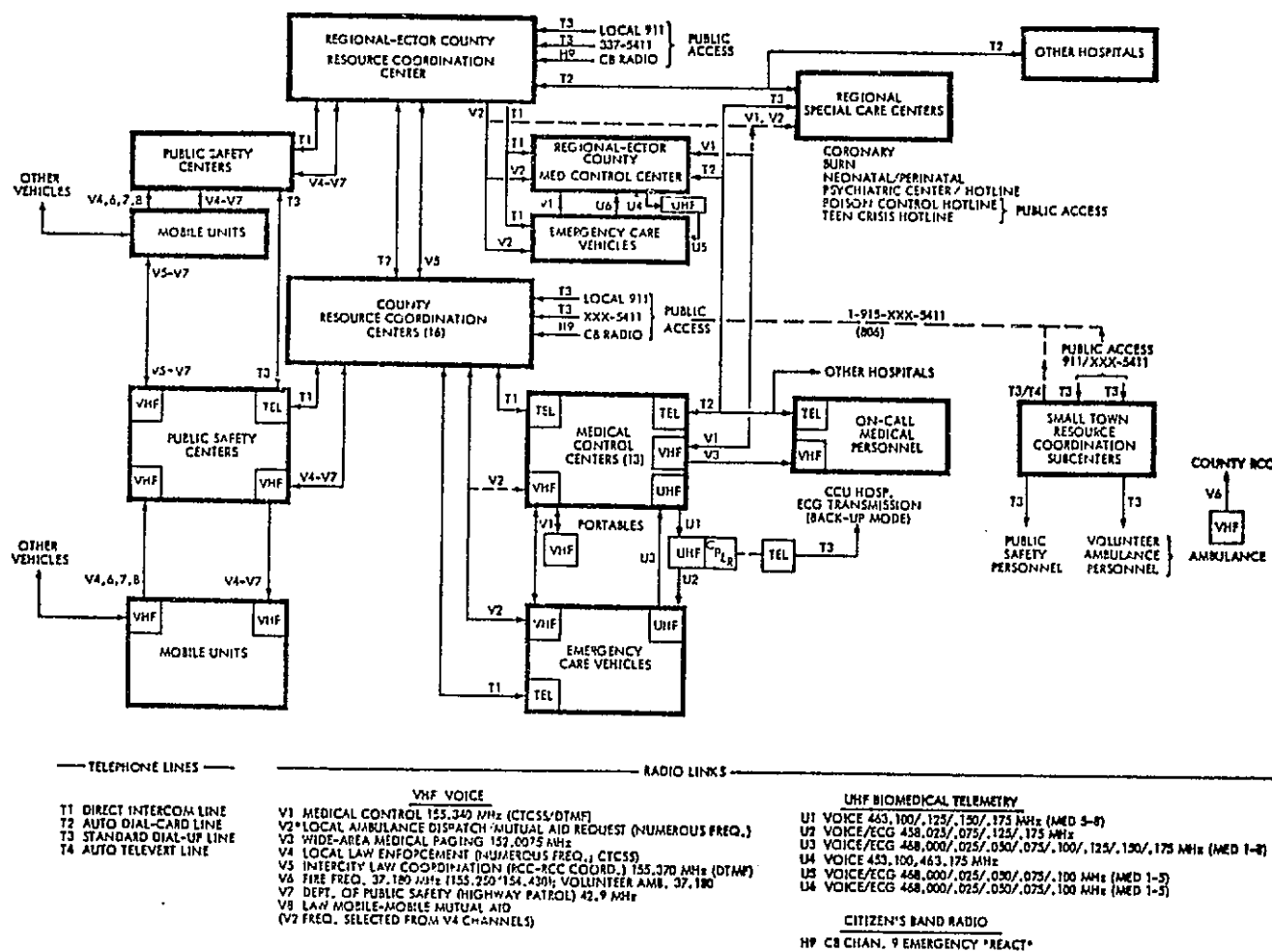


FIGURE 6. - COMMUNICATIONS CONSOLE - MEDICAL CONTROL CENTER

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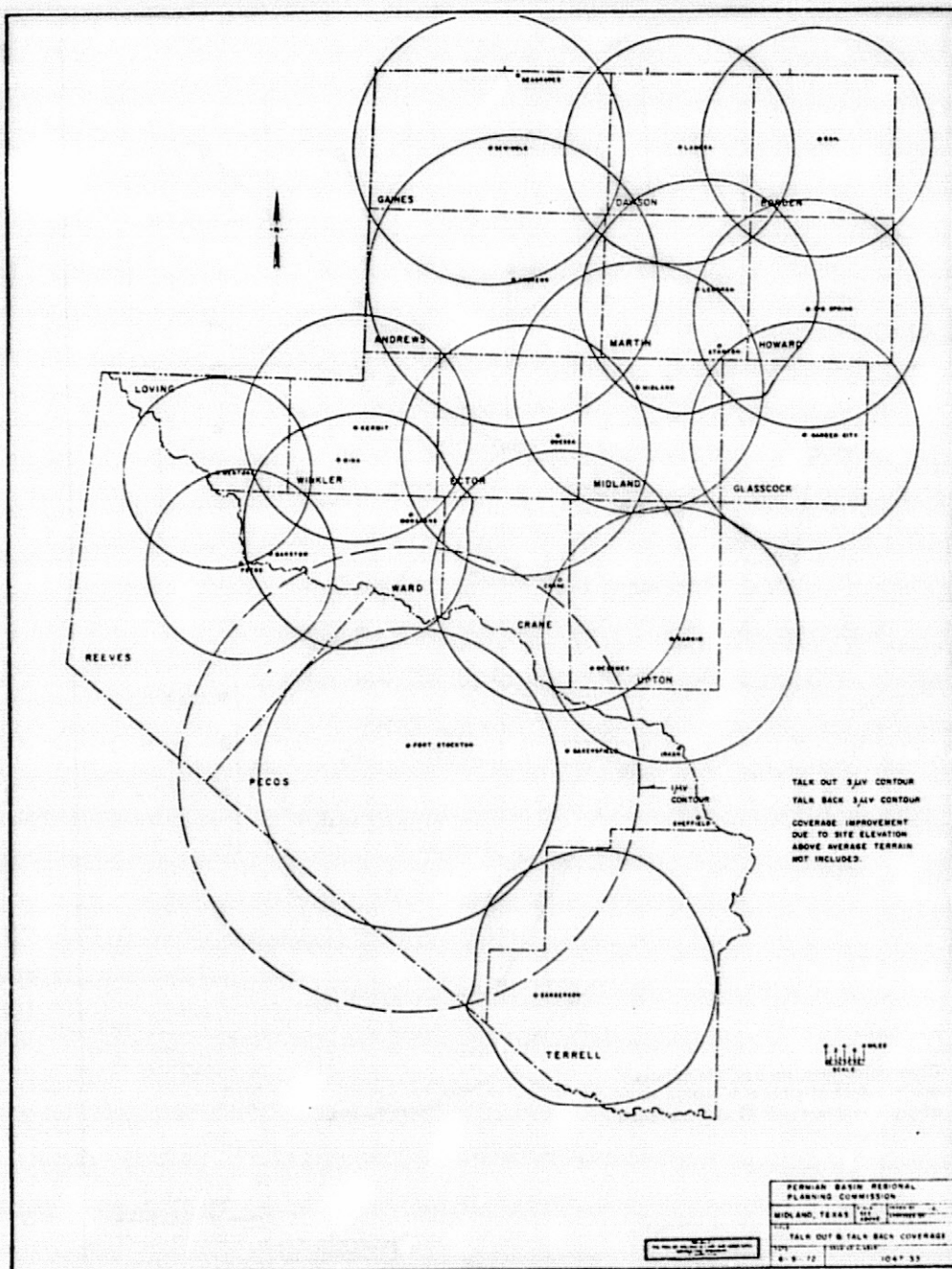


FIGURE 9. - RADIO COVERAGE, RESOURCE COORDINATION CENTER TO AMBULANCE

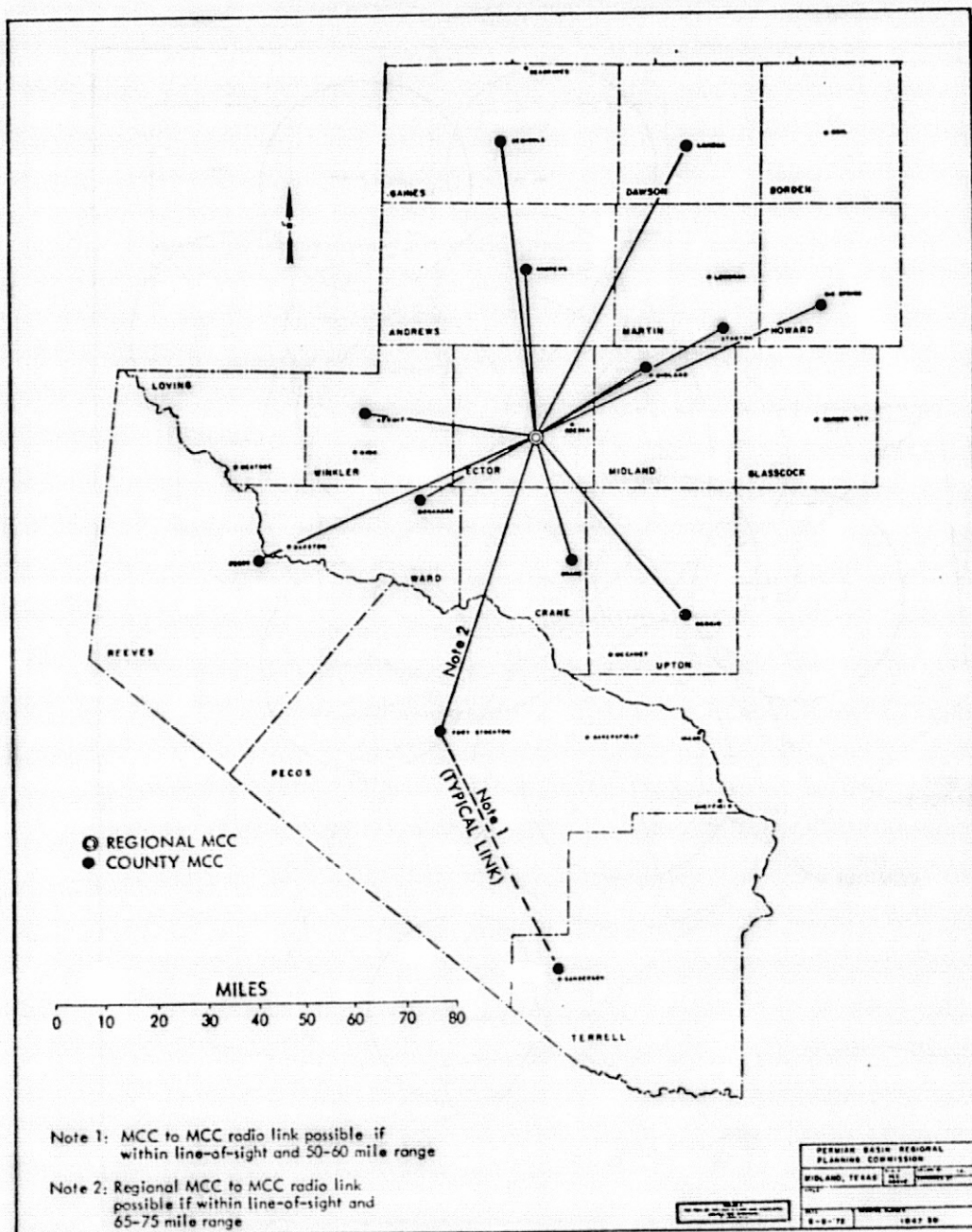


FIGURE 10.- INTER-COMMUNICATIONS, MEDICAL CONTROL CENTERS

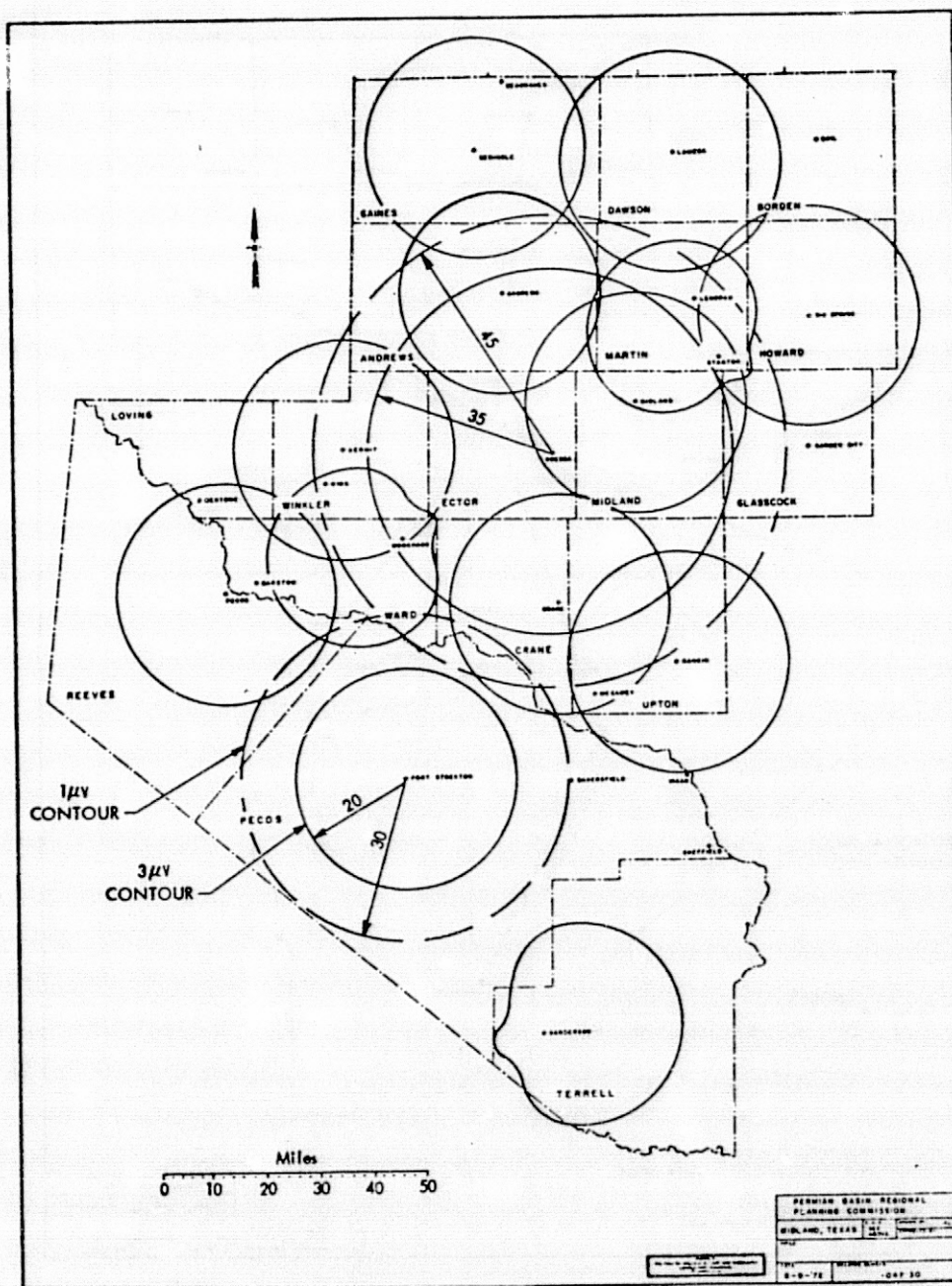


FIGURE 11. - RADIO COMMUNICATION COVERAGE,
MEDICAL CONTROL CENTERS TO AMBULANCES

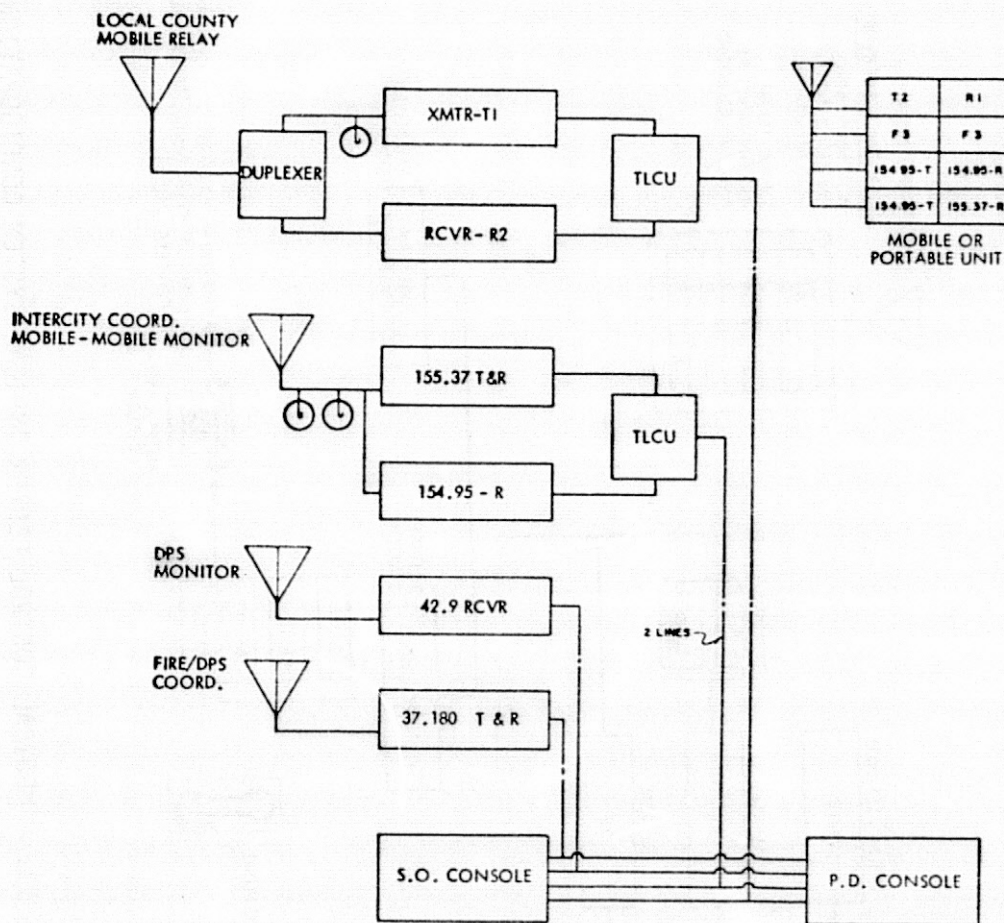


FIGURE 12. - TYPICAL CRIMINAL JUSTICE COMMUNICATIONS SYSTEM
(RESOURCE COORDINATION CENTER COOPERATIVE UTILIZATION)

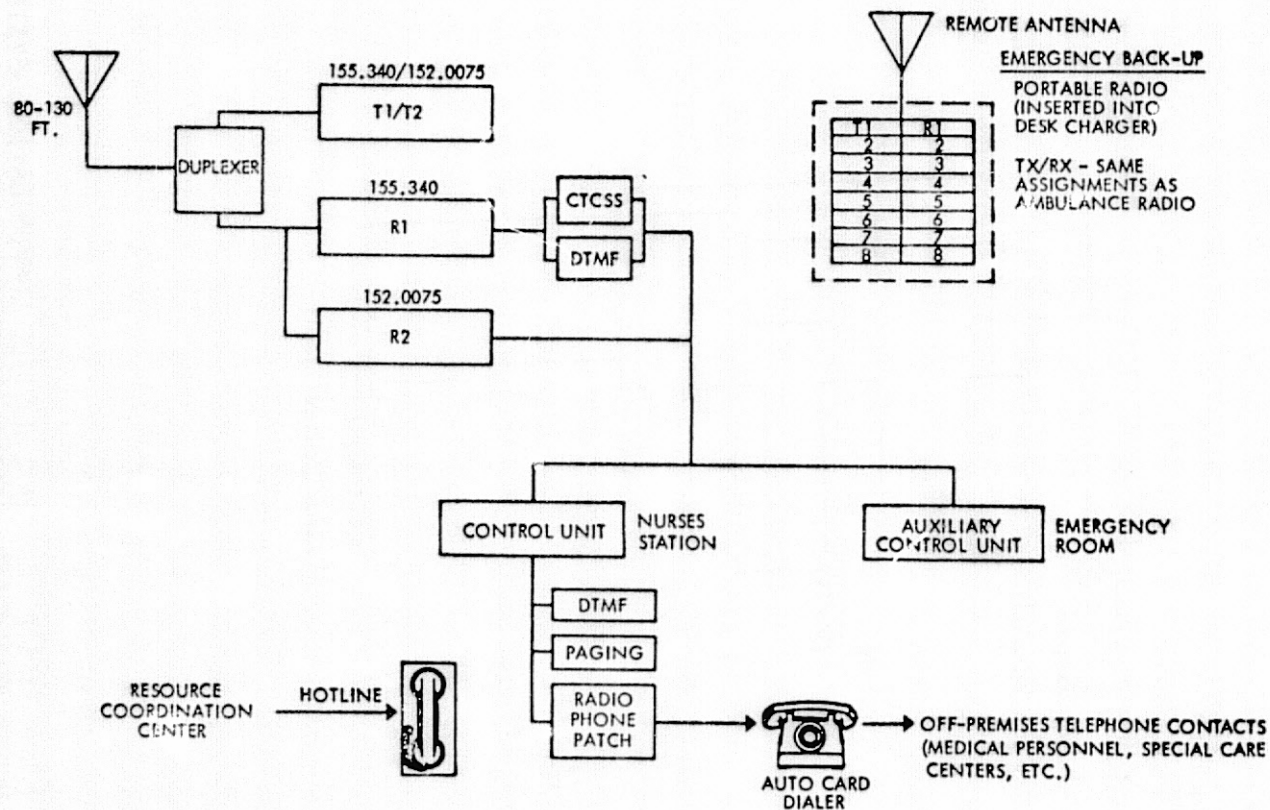
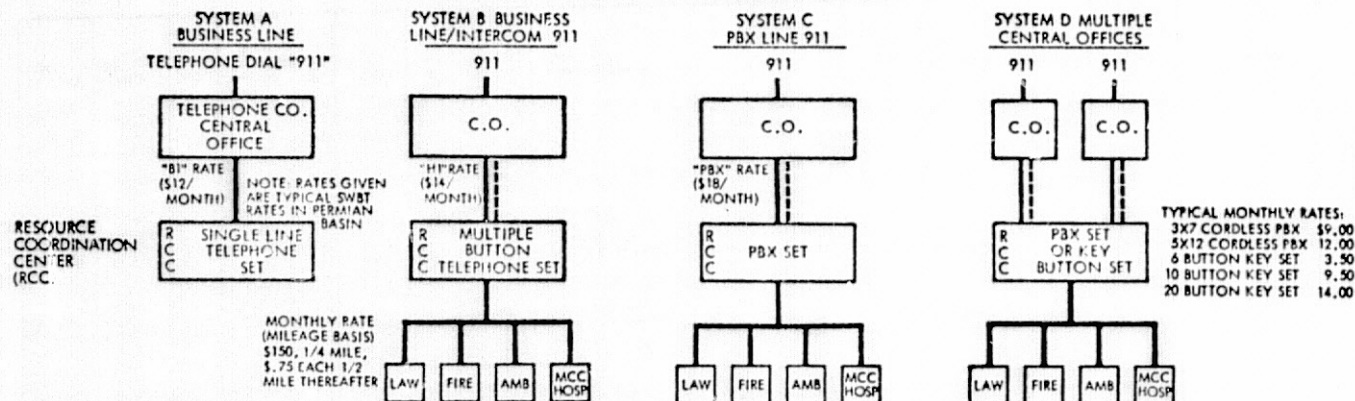


FIGURE 13. - MEDICAL CONTROL CENTER TYPICAL SYSTEM CONFIGURATION

I. DEDICATED TRUNK CONFIGURATIONS



II. TANDEM TRUNK CONFIGURATIONS

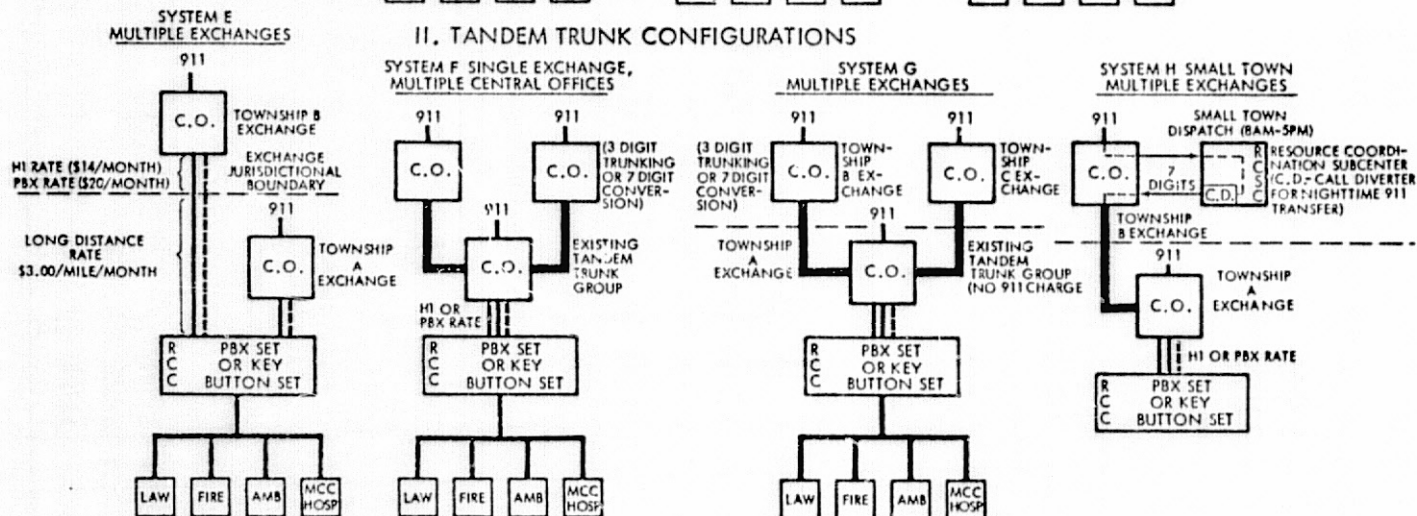


FIGURE 14. - TYPICAL 911 SYSTEM CONFIGURATION

TABLE II. - COMMUNICATIONS SUMMARY, RADIO AND TELEPHONE

RESOURCE COORDINATION CENTER				MEDICAL CONTROL CENTER			
LOCATION		NOTIFICATION CONTROL		AMBULANCE CONTROL		HOSPITALS	
COUNTY (POP.)	CITY (POP.)	AGENCY	TELEPHONE	OPER.	UNITS/DISPATCHER	MCC HOSPITAL	SUPPORT FACILITIES
ANDREWS (10,297)	ANDREWS (8,625)	P.D.	a. 911 (TBD) b. 323-5411 (Com'l. Tel.)	P.D.	2 155.470/ 154.785 (158.820)	Perman General (III) (523-2200)	Community General (IV) (523-4911)
BORDEN (188)	GAIL (175)	S.O.	a. 911 (TBD) b. 855-5411 (Perman-Lambert Co-Op)	(TBD)	(1) 155.720/ 154.725	Medical Arts (III) (Dorman County) (806-872-2183)	Snyder Hospital (Snyder County)
CRANE (4,172)	CRANE (3,927)	P.D.	a. 911 b. 558-5411 (SWBT)	(TBD)	(1) 155.565/ 154.815	Crane Memorial (IV) (558-3555)	
DAWSON (16,454)	LAMEZA (11,359)	P.D.	a. 911 (E) b. 872-5411 (General Tel.)	PVT	2 155.565/ 154.815	Medical Arts (III) (806-872-2183)	
ECTOR (91,303)	ODESSA (78,380)	P.D.	a. 911 (E) b. 327-5411 (SWBT)	P.D.	3 155.220	Medical Center (II) (Burn, Coronary Care Center) (327-7311)	Women's & Children's Hosp. (Perman/ Memorial Center) (P&H-XXXX)
GAINES (11,993)	SEMINOLE (5,007)	S.O.	a. 911 b. 758-5411 (SWBT)	Vol. (Goldsmith)	1 37.180	Memorial (IV) (758-3628)	Polson Animal Center (XXXX-XXXX)
GLASSCOCK CITY (1,135)	GARDEN (280)	S.O.	a. 911 (TBD) b. 354-5411 (Mer-Net Co-Op)	P.D. (Saggraves)	2 155.625/ 154.650	Mallone & Hagan (III) (Howard County)	Hobbs Hospital (Hobbs, N.M. Hospital)
HOWARD (27,795)	BIG SPRING (78,725)	P.D.	a. 911 b. 263-5411 (SWBT)	(TBD)	(1) 155.655/ 154.860	Mallone & Hagan (III) (Howard County)	Hobbs Hospital (Hobbs, N.M. Hospital)
LOVING (154)	MENTONE (80)	S.O.	a. 911 (TBD) b. 377-5411 (Com'l. Tel.)	S.O.	1 155.595/ 154.875 (155.590)	Memorial (Burns County) (447-2221)	Hall-Bennett Hosp. (III) (278-7361) Big Spring State (III) (Psychiatric Center) (267-5216) Custer Clinic & Hosp. (IV) (263-7421) Hobbs Hospital (IV) (263-7294) Webb AFB Hosp. (267-2611)

RESOURCE COORDINATION CENTER				MEDICAL CONTROL CENTER											
LOCATION		NOTIFICATION CONTROL		AMBULANCE CONTROL		HOSPITALS		MCC COMMUNICATIONS							
COUNTY (POP.)	CITY (POP.)	AGENCY	TELEPHONE	OTHER	UNITS	DISPATCHER	MCC HOSPITAL	SUPPORT FACILITIES	TELEPHONE		RADIO - VOICE		RADIO-TELEMETRY		
									RCC HOTLINE	TEL-RADIO	PAGING	VOICE		ADDRESS ASSIGNMENT	DTMF
ANDERSON (10,397)	ANDERSON (8,025)	P.D.	a. 911 (780) b. 523-5411 (Central Tel.)	P.D.	2	155.670/ 154.755 (158-880)	Penitentiary General (III) (523-2200)	Community General (IV) (523-491)	X	523-XXXX (915)	155.340	71.9	523	Portable 3 Units Tx=463.000 .075/.050/ 075 .100 Rx=453.100 .463.175 Vox. Register Tx=468.000 .075/.050/ 075 .100	
ROZEM (158)	GAIL (175)	S.O.	a. 911 (780) b. 523-5411 (Harris-Lamar Rural Tel. Co-Op)	(TBD)	(1)	155.730/ 154.725	Medical Arts (III) (806-872-2182)	Snyder Hospital (Snyder County)	-	872-XXXX (806)	155.340	77.0	872		
CRANE (4,172)	CRANE (3,927)	P.D.	a. 911 b. 558-5411 (SWBT)	(TBD)	(1)	155.565/ 154.815	Crane Memorial (IV) (558-3555)		X	558-XXXX (915)	155.340	74.4	558		
DAWSON (16,504)	LAMESA (11,239)	P.D.	a. 911 (8) b. 872-5411 (General Tel.)	PVT	2	155.565/ 154.815	Medical Arts (III) (806-872-2182)		X	872-XXXX (806)	155.340	77.0	872		
ECTOR (91,303)	ODESSA (78,380)	P.D.	a. 911 (8) b. 337-5411 (SWBT)	P.D.	3	155.220	Medical Center (II) (Harris-Lamar County Care Center) (337-2311)	Women's & Children's Hosp. (Harris-Lamar County) (XXXX-XXXX)	X	337-XXXX (915)	155.220 155.340	79.7	337		
				Vol. (Gardner)	1	37.180		Prison Control Center (XXXX-XXXX)	X						
GAINES (11,293)	SEMINOLE (5,007)	S.O.	a. 911 b. 758-5411 (SWBT)	S.O.	2	155.625/ 154.650	Memorial (IV) (758-3628)	Holiba Hospital (Holiba, N. M. Hospital)	X	758-XXXX (915)	155.340	82.5	758		
GLASSCOCK (1,135)	GARDEN CITY (780)	S.O.	a. 911 (780) b. 334-5411 (Harris-Lamar Co-Op)	P.D.	2	155.625/ 154.650 (Saginaw)	Mallons & Hagan (III) (Harris County)		-	263-XXXX (915)	155.340	85.4	263		
HOWARD (37,795)	BIG SPRING (78,725)	P.D.	a. 911 b. 263-5411 (SWBT)	(TBD)	(TBD)	155.535/ 154.755	Mallons & Hagan (III) (County Care Center) (263-1211)	Hall-Burnett Mem. (III) (276-2411) VA Hosp. (III) (263-2301) Big Spring State (III) (Psychiatric Center) (267-6216) County Clinic & Hosp. (IV) (263-1211) Harris-Lamar County Clinic & Hosp. (IV) (263-2294) Webb AFB Hosp. (267-2611)	X	263-XXXX (915)	155.340	85.5	263		Portable 2 Units Tx=456.055 .075/.125/.125 Rx=463.100 .125/.150/.175 Vox. Register Tx=468.000-468.175 (8 Chan.)
LOWING (134)	MERTONE (90)	S.O.	a. 911 (780) b. 372-5411 (Central Tel.)	S.O.	1	155.595/ 154.875 (155.3500)	Memorial (Reserve) (447-2221)		-	447-XXXX	155.340				447

Portable 3 Units
Tx-453.000/.025/.050/
.075/.100
Rx-453.100/.465/.175
Ver. Receiver
Tx-468.000/.025/.050/
.075/.100

Portable 2 Units
Tx-453.025/.075/.125/
.175
Rx-453.100/.125/.150/.175
Ver. Receiver
Tx-468.000-468.175
(8 Chan.)

TABLE II. - COMMUNICATIONS SUMMARY, RADIO AND TELEPHONE (Continued)

RESOURCE COORDINATION CENTER				MEDICAL CONTROL CENTER									
LOCATION		NOTIFICATION CONTROL		AMBULANCE CONTROL		HOSPITALS		MCC COMMUNICATIONS				RADIO-TELEMETRY	
COUNTY (POP.)	CITY (POP.)	AGENCY	TELEPHONE	OPER.	UNITS	DISPATCHER	HOSPITAL	SUPPORT FACILITIES	RCC HOTLINE	TEL-RADIO	PAGING	VOICE	ADDRESS ASSIGNMENT CTCSS DTMF
MARTIN (4,774)	STANTON (2,117)	P.D.	a. 911 b. 756-5411 (SWBT)	HOSP.	1	155.905/ 154.875	Marlin County Hosp. (756-2775)		X	756-XXXX	-	152.0075	91.5 756
MIDLAND (45,433)	MIDLAND (59,443)	P.D.	a. 911 b. 683-5411 (SWBT)	(P.D.)	2	155.120/ 154.800 (155.430)	Midland Memorial Emergency Care Center (682-7381)	Polkville Hosp. 48 (652-5411) Polk County Central Cancer (XXX-XXXX)	X	682-XXXX	152.0075	155.340	94.8 682
PECOS (16,324)	PT. STOCKTON (8,263)	P.D.	a. 911 b. 330-5411 (SWBT)	P.D.	2	155.335/ 154.785 37.180	Memorial (330-2241)	General Hosp. - Iron (659-2871)	X	330-XXXX	152.0075	155.340	97.4 330
REEVES (16,324)	PECOS (17,487)	P.D.	a. 911 (TRD) b. 445-5411 (Cont'l. Tel.)	P.D.	2	155.520	Memorial (447-2222)		X	447-XXXX	152.0075	155.340	100.0 447
TERRELL (1,240)	SANDERSON (1,229)	S.O.	a. 911 b. 345-5411 (SWBT)	S.O.	1	155.655/ 154.860	Sanderson Clinic (345-XXXX)	Memorial (Pecos County) (330-2241)	X	345-XXXX	152.0075	155.340	100.5 345
UPTON (4,597)	BANKIN (1,100)	CITY S.M.A.L.L. SHALL	a. 911 b. 693-5411 (SWBT)	Hosp. Dis. Vol. (McCommy)	1	155.550/ 154.820	Renton County Hospital (813-2445)	McCommy Hospital (652-8556)	X	693-XXXX	152.0075	155.340	107.2 693
WARD (13,019)	WOMAHANE (6,287)	P.D.	a. 911 b. 943-5411 (SWBT)	PVT	2	155.790/ 154.725 37.180	Memorial (943-2311)		X	943-XXXX	152.0075	155.340	110.9 943
WINKLER (7,640)	KERMIT (7,884)	P.D.	a. 911 b. 586-5411 (SWBT)	Vol. Granddell P.D.	2	155.640/ 154.756	Memorial (586-2311)		X	586-XXXX	152.0075	155.340	114.8 586

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APPENDIX A EMS COMMUNICATIONS STANDARDS

COMMUNICATIONS STANDARDS. A detailed set of standards and guidelines has been developed in order to provide the basis for a well-planned regional communications network.

1. Single-Entry Public Access Emergency Telephone Number

- a. Implement to the Resource Coordination Center (RCC) the 911 emergency telephone number which has been adopted federally and by the telephone industry as the nationwide emergency number. Place implementing priority in those areas of highest population density.

Consider auxiliary services of (1) switch-through control to allow 911 caller to be connected directly to specific agency, (2) hold-line-open control to allow tracing of false alarms, (3) re-ring control to allow recontact with emergency caller, and (4) dial-tone-first control to allow 911 to be called on public phone without first depositing a coin.

- b. Implement in areas not having 911 availability (technical, scheduling, or financial limitations) a standard 7-digit dial-up number, preferably easily memorized, which can provide direct entry access to the RCC, e.g., XXX-5411.

- c. Consider in areas not having a locally dialed RCC the provision for a direct access toll-free number to the Regional RCC.

- d. Implement a public educational program to ensure citizen awareness of the single-entry telephone number. The number should be posted on the side of ambulances, on the first page of telephone directories, and on public telephones. TV announcements should be made when the number is initially implemented, and emergency number stickers should be mailed to all telephone subscribers.

Note: Experience has shown that in many locations half or more of incoming 911 calls are non-emergencies, which have the detrimental effect of tying up the emergency line and possibly overloading the RCC dispatcher. This is due to public misinformation or misuse. In part, this has been frequently attributed to non-explicit information on the first page of telephone directories. A more detailed listing is needed. For example:

EMERGENCIES ONLY

- Call 911 (Vehicle Dispatch Only - Fire, Police, Sheriff)
- Call 911 (Ambulance/Trained Emergency Medical Technician)
- Call (1-XXX)XXX-XXXX (Poison Control Center - Give city and medical center name) or call 911
- Physician () (person's private physician's number)

Areas Not Served by 911 Lines (Towns of):

- Call (1-XXX)XXX-XXXX (Resource Coordination Center, City of)
- e.g., XXX-5411 (pseudo 911 number)

Other Considerations:

- Call (1-XXX)XXX-XXXX (Teen Crisis Hotline)

NON-EMERGENCIES

- Police - XXX-XXXX
- Sheriff - XXX-XXXX
- Fire Department - XXX-XXXX
- Department of Public Health - XXX-XXXX
- Department of Public Safety - XXX-XXXX (Highway Patrol)
- Ambulance - XXX-XXXX
- Medical Referral Service - XXX-XXXX (County Medical Society)

2. Resource Coordination Center(s) (RCC)

- a. The RCC should receive all requests for emergency response, and all responses (after verbal screening to ensure necessity of emergency action) should be directed from the center. Operation should be 7 days per week, 24 hours per day.

- b. The central RCC may be a self-contained communications center having a full complement of telephone and radio communications channels under direct control, or may be interconnected with other public service centers which control their specific agency communications functions.

- c. An RCC may be established in any general area where effective overall coordination of public services is needed. Therefore, RCC's may be established in both large and small regional areas. An RCC may cover a multi-county area, a county area, or a city area. Where more than one RCC exists in a region, an effective communications link must be established among them to ensure rapid coordination when needed for any wide-area response.

- d. The RCC should maintain primary responsibility for emergency medical service coordination except for actual medical consultations and "patient-care-vectoring" decisions which are under EMT-hospital staff control. When an ambulance is being locally dispatched into an adjacent county area for the purpose of patient pick-up or delivery of patient to the nearest or to a special care hospital, the local RCC should coordinate the ambulance arrival with the applicable county RCC. That RCC should then coordinate with the applicable hospital and any other involved public service groups concerning the impending ambulance duty in that county.

- e. Telephone communications with other public service groups should be generally as follows:

- (1) Direct, private, non-dial telephone circuits (intercom or "hot line") should be established to police, fire, sheriff, ambulance company, and Medical Control Center. These lines should be capable of being selectively tied together to allow the RCC to give information simultaneously to all applicable groups. The incoming 911 line should also be capable of direct tie-in with the other intercom lines.

- (2) A separate RCC telephone should be available for dial-up lines needed frequently or on contingency basis. Typical usage would be for contacting other RCC's, other hospitals (Medical Control Center is the only hospital on direct intercom line), city and county offices, etc. Consideration should be given to the potential effective use of an inexpensive automatic dialing system (punched card, tape memory, etc.) which could store all numbers needed.

- f. Radio communications with other public service groups should be implemented for the following types of coordination duties:

- (1) In-transit dispatching/mutual aid coordination to ambulances and other medical emergency vehicles
- (2) Coordination to Medical Control Center
- (3) Coordination with other public safety agencies: police, fire, sheriff, DPS, etc.
- (4) Coordination with other RCC's
- (5) Coordination to varied points by means of radio-to-telephone patching

- g. A radio monitor should be available on citizen's band emergency channel 9 (REACT).

- h. The RCC should have some protection against self-emergencies such as loss of electrical power or loss of telephone service, etc. A backup mode of operation (equipment or procedural) should be available to perform critical functions.

- i. The use of a tape recorder should be considered for recording information given by emergency caller (re-check address, etc.) and for recording relayed information to other dispatch agencies (legal consideration).

3. Medical Control Center(s) (MCC)

- a. The MCC should receive directly all EMT requests for medical consultation and patient care vectoring, and all medical responses should be directed from the center. Operation should be 7 days per week, 24 hours per day.

- b. The MCC, like the RCC, may be established in any overall area where effective medical consultation is needed. Where possible, the MCC should be a principal hospital having a good emergency room staff.

- c. The MCC is the focal point for emergency medical consultative communications.

- (1) A dedicated (non-dial) telephone circuit from the RCC should be provided to the nurses' station and/or emergency room. A separate (preferably unlisted) dial-up telephone (auto-dialing card consideration) should be available for contacting outside medical personnel, specialized medical centers (burn, poison control, psychiatric, etc.), other area hospitals, etc. A radio-to-telephone patching device should also be available to allow the EMT to talk directly to specialized medical centers, e.g., psychiatric, poison control.

- (2) Two-way voice VHF (simplex) or UHF (duplex) radio communications from the EMT to the MCC should be implemented. The EMT may require medical advice at the scene using a portable radio (range limited) or the ambulance radio. In-transit medical consultation may also be needed.

4. Emergency Care Vehicles

- a. Communications with the RCC and MCC have been developed in the preceding paragraphs 2.f.(1) and 3.c.(2). The ability to transmit and receive shall be by both the driver and the patient attendant in the rear compartment. The hospital selective address device, if utilized, should be in the patient compartment.

- b. Consideration should be given to the capability of connecting the portable biomedical telemetry radio to a separate ambulance antenna if the unit is being used in the patient compartment. A connection to the ambulance battery power should also be considered. A hands-free headset/foot switch should be considered as an accessory for the patient compartment.

- c. A communications intercom link between the driver and patient compartment should be provided.

- d. A public address hailer should be considered.

5. Radio Channel Allocation, FCC Rules and Regulations

- a. The assignment of radio channels (VHF or UHF band, number of channels, specific frequencies, etc.) should be recognized as a difficult problem due to the large amount of regional and state coordination that is required. Points that must be studied are as follows:

- (1) Present and future (15-year period) radio traffic loading on local and regional basis.
- (2) Need for simultaneous transmissions among various medical facilities and emergency care vehicles.
- (3) Need for separate medical paging channel, ambulance dispatching channel, common-calling channel, mutual aid channel, etc.
- (4) Need for vehicular or fixed repeater stations for wide area radio coverage.
- (5) Degree of radio frequency congestion (present and future) from other qualified users of Special Emergency Radio Service (SERS), e.g., rescue organizations, veterinarians, school buses, etc.
- (6) Method of eliminating congestion, interference, or botherance from multiple EMS radio users and other radio systems. The priority of methods should be (a) different frequencies (even among EMS users) with adequate guard bands, (b) same frequency but adequate geographical spacing (distance, terrain, antenna height, and RF power considerations), and (c) selective channel addressing by single fixed

APPENDIX A

- tone, selectable different tones, or digital dialing; (pulsed fixed tone or dual-tone multiple frequencies). The last method eliminates "botherance" but not potential co-channel interference.
- b. Radio networks must conform to all FCC requirements. A regional frequency coordinator should be assigned and all proposed plans should be submitted to State Department of Health for review.
- 6. Equipment Standards
 - a. The EMS communications should be designed around "state of the art" equipment available from several reputable manufacturers. The equipment should meet EIA and FCC standards.
 - b. Equipment selection, assembly, and installation should consider specific human factor situations in the usage locations. Communications equipment operated by hospital personnel should have simplistic controls and should be installed at most convenient usage locations.
 - c. Provisions for future expansion should be included; e.g., add-on capability and extra capacity features such as blank cabinet space and panels, reserve connectors, spare switches, extra channel capacity, spare wires in cabling, etc.
 - d. Methods of signaling, such as tone, digital, etc., must be carefully chosen to interface with all elements of the system at the city, county, and regional level.
 - e. All equipment should be supplied with complete service manuals and parts lists. Factory service guarantees and/or service contracts should be specified at the time of purchase. Periodic maintenance should be planned.
 - f. Competitive procurements should be established (price quotes 20% or more below list price are frequently obtained on large regional purchases).
- 7. Personnel Training
 - a. All personnel operating radio equipment must have adequate training to ensure compliance to FCC requirements (protocol, language, etc.).
 - b. Training should be individually tailored for personnel in mobile units (ambulances) and base stations (Resource Coordination Center, Medical Control Center). Training should be sufficient to allow personnel to utilize equipment in a natural, self-confident, and effective way.
 - c. Training should be an integral and formal part of EMS medical courses. Actual equipment models should be available for hands-on training. Personnel should have a full understanding of the radio system network and its limitations.
 - d. A Communications Manual should be available for all trainees. (Illinois "Herci" manual is an excellent example.)
 - e. Training of the REC or MCC personnel should include the ability to give self-help instructions to the person reporting the emergency. REC personnel preferably should have EMT training.
 - f. Training of REC and ambulance personnel should include a concise way of radio-dispatching ambulances to the exact emergency scene location using detailed grid maps, a special notation card file, etc.
 - g. Training of REC communications personnel should include emphasis on accurate time/event records to allow subsequent evaluation of EMS response times. (Time stamp clock should be considered.)
- 8. Disaster Planning
 - a. System design features should include contingency plans for multiple wide-area emergencies. The specifics of this planning have been generally covered in previous standards, namely, coordinated regional system, effective communications interface among the various public safety agencies, hospital-to-hospital communications, availability of portable radio units, communications backup links, emergency or battery power sources, etc.
 - b. Civil Defense (disaster relief) personnel should be thoroughly familiar with the local and regional EMS communications network and should have mobile/portable radio equipment available for use.
- 9. Organizational Elements and Manpower Resources
 - a. The EMS communications system should be designed to meet the medical needs of the Region within the framework of existing organizational structure, governmental agencies, medical groups, and businesses. Regional planning requires the active involvement and commitment of all groups having a major role in present and future EMS activities. Official recognition of regional planning agencies and emergency care committees (hospital administrators, county medical societies, local public health officials, ambulance companies, EMT's, etc.) should provide the basis for detailed planning.
 - b. Maximum use of existing public service groups and facilities should be planned. Existing public agency dispatch personnel (expansion of duties and responsibilities) should be considered for use as communications coordinators in the Resource Coordination Center.
 - c. A regional EMS administrator may be required to ensure on-going planning, operational efficiency, system performance evaluation, etc.
 - d. Regional communications planning groups should coordinate with adjacent regions and with the State to ensure overall compatibility and information flow.
- e. Communications system engineering (governmental or private consultant) must be considered for the initial one- to two-year design, procurement, installation, and test period.
- 10. Financial Resources and Priority Allotments
 - a. The EMS communications design should consider the financial resources that are available for engineering design, equipment purchase, and yearly operation expenses. Priority decisions are generally required so that the basic framework implementation can be scheduled promptly, with additional expansion or technical advancement planned at a subsequent date. The initial system design should ensure that later expansion can proceed in a compatible fashion with the basic framework.
 - b. Existing communications equipment, facilities, and manpower should be used where possible to obtain a cost effective program. Existing equipment frequently can be modified at less expense than new equipment purchase.
 - c. Planning and negotiations with the telephone companies should take first priority since long lead times of 18 to 24 months are not uncommon before the necessary telephone lines are installed. Various alternative configurations should be critically explored to arrive at the most cost effective approach.

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THE LOS ANGELES COUNTY SYSTEM:
AN HISTORICAL ANALYSIS

James O. Page, J.D.

In this age of cookbook directions to building EMS systems, it is hard to imagine an attempt to develop an effective emergency health care system without plans, directions, "laundry lists," federal program regulations, and the copious advice of a world full of self-annointed consultants. Two years after Federalese became the official language of emergency health care systems, it is hard to remember when improvements in the system (or non-system) could be accomplished without a 1202 grant.

Four years before Public Law 93-154 became a reality, an effort began in Los Angeles which lacked the advantage of a formal plan, or a planning grant, but which would bring together people, circumstances, disciplines and fortuitous events in what must be considered a health care revolution. The vision and dedication of a medical doctor was complemented by his rare ability to quietly commit others to the cause of improved and more effective emergency health care. He was impressed by the work of Pantridge, Nagel and others and sought to see the developments in Belfast and Miami come to fruition in that incredible, unmanageable megalopolis known as Los Angeles County.

J. Michael Criley is a cardiologist and his desire in 1969 was to develop a better system of prehospital care and transportation for cardiac emergencies. He had concluded that the concept of a rolling emergency room, complete with medical staff, was too expensive and cumbersome to satisfy the needs of most communities. Although his primary interest in 1969 remained with the problem of the cardiac emergency, he sought to develop an alternative to the vehicular emergency rooms which had evolved from the dreams of other cardiologists throughout the world.

Associate City Attorney
Raleigh, North Carolina

Prior to 1969, Dr. Criley had had little contact with firemen. In seeking personnel to train for the prehospita aspects of his project, he was faced with a need for trainable, stable and dependable people that he didn't have to pay anything for. Firemen stationed in the vicinity of Harbor General Hospital in south Los Angeles seemed to fill the bill.

It was September 16, 1969, when the first small group of firemen arrived at Harbor General Hospital to participate in a special training program which would evolve as it progressed. Dr. Criley had arranged for a coronary care unit nurse to conduct and coordinate the training process throughout the five month period which was to follow. Harbor General Hospital, being a teaching institution associated with U.C.L.A. School of Medicine, had the capability to provide the trainees with the staff support and patient load which would make the clinical and practical aspects of the training meaningful.

The choice of personnel for the project had seemed risky at first. However, the attitude and performance of the trainees quickly convinced Dr. Criley and his training nurse that the firemen had been an excellent choice. They quickly absorbed the training materials and exhibited rapid progress in developing the practical skills which they would take to the community.

Given the history of Los Angeles County politics, and the fragmented structures and organizations which plan for and attempt to implement changes and improvements in health care in the area, a more planned approach to the Los Angeles County "paramedic program" would have probably killed it in its early stages. It needed to develop a momentum which could mow down foot-dragging resistance to change and perceived threats to traditional territory. That momentum would have never developed in the format of non-productive bickering and indecision which were the hallmarks of Los Angeles County's health planning of that era.

The relatively unplanned approach left many holes, surprises, unanswered questions, and obstacles to be confronted. For example, at the time the first firemen were completing their paramedic training program, it became apparent that there was no provision in California law which would permit them to function as desired. Thus, as the newly-trained personnel first began to take their skills into the field, they were accompanied by nurses who had the legal authority to perform the patient care functions which were the essence of the program.

Meanwhile, the California Legislature attempted to be creative in developing a statutory scheme which would provide the needed legal authority. The result was to provide the desired authority but also set the stage for future problems. The statute, labelled the "California Mobile Intensive Care Paramedic Act" was flawed by its hasty and unplanned preparation. It gave legislative blessing to the presumptive concept that a specified number of training hours will produce an adequately prepared paramedic functionary. It placed responsibility for control and certification of paramedic personnel in the hands of county health officers, most of whom were totally unprepared for the task and responsibility. It defined permissible paramedic functions by statute, with detailed specificity, thus setting the stage for political turmoil as growth and evolution of the concept disclosed the need for change.

A key element in any advanced EMT, or paramedic, approach to prehospital emergency care has proven to be the electronic link of telemetry. In the Los Angeles County program, there was the advantage of a local resource in the form of an experienced manufacturer of medical electronics which had pioneered in the development of portable telemetry transceivers and hospital console equipment.

With the implementation of the pilot paramedic unit in Los Angeles, there was no apparent need for a sophisticated systems approach to radio communications. The first unit was to operate within several miles of Harbor General Hospital, radio hardware was available which would provide for episodic broadcast from that unit to the hospital, and a developmental frequency was available from the Federal Communications Commission (FCC). A more planned approach might have projected the phenomenal acceptance and growth of the program beyond the first pilot unit. Absent such planning, immediate needs were recognized and satisfied by purchasing hardware, installing an antenna, plugging it in and turning it on.

As the initial paramedic group completed their training and the statutory authority became effective in allowing them to function without nurse supervision, a period of nervousness ensued among those who had envisioned the program and worked to create it. The test would come as experience built. Could these paramedic firemen really stabilize a myocardial infarction miles from a hospital? Could they perform the necessary crisis care functions in the gutter, outside a sanitized and controlled environment? Did it make any sense for them to perform their paramedical heroics when the patient could be delivered untreated to a hospital within a few minutes?

A more planned approach might have established an evaluation which could answer these and a multitude of other questions in a scientifically defensible format. Such an evaluation effort might have preceded implementation to establish a base line measure of medical emergency outcomes against which the new approach could be compared.

As the new paramedics were being trained and implemented through the U.C.L.A. School of Medicine (Harbor General Hospital campus), the U.C.L.A. Graduate School of Business Administration was involved in theoretical analyses of emergency medical services (EMS) and related service problems in the urban area of Los Angeles. A more planned approach might have involved that academic program in development of a scientifically acceptable evaluation methodology before implementation of the paramedic program. In retrospect, it can be seen that the product of such involvement, however, would have been so theoretical and sophisticated in its format and language that it would have evaded the comprehension of those political figures whose support would have been essential to its adoption.

Despite the absence of a formal evaluation mechanism, the first paramedic team to be implemented promptly began to log an impressive number of dramatic "saves." For the first several months, the program was small and new enough to recall and relate accounts by patient name, rather than statistical data. Detached scholastic commentary of today scorns the "insidious tradition which permits loose use of 'facts and figures' to clothe the anecdotal and intuitive evidence" which assured Dr. Criley and his associates that the program was meritorious and financially sound.*

Meanwhile, in the real world of politics, a very astute Los Angeles political figure was quick to recognize the benefits of close identity with a program of lifesaving dramatics. Assuming a patron's role over the program, the politician displayed increasing interest and support for the concept and its expansion. What he sought and got was not a professional EMS planning team, nor an evaluation methodology which would disdain anecdotal and intuitive evidence for an academically acceptable body of data. He did not seek a correlative study of the paramedic approach and its affect upon overall utilization of the overall health care system. He voiced no concern for study of the potential abuse of a prehospital care system by non-emergency patients. He displayed no interest in a simulated model of demand for emergency ambulances in the region.

*Willemain, Thomas R.

The Status of Performance Measures for EMS

Technical Report 06-74, Operations Research Ctr., MIT

He wanted and got more of what had been developed as a pilot approach. He wanted and will eventually have a paramedic unit readily accessible to every citizen in the county.

As the first unit accumulated experience, it became obvious that strict orientation to heart-related emergencies would not suffice. Less than 30% of the calls being answered by the first unit were related to true cardiac emergencies. The paramedic personnel were engaged in rendering a wide variety of permissible emergency functions to patients suffering from a wide variety of medical emergencies. The first group became engaged in a continuing education program to expand their mobile coronary care role to that of mobile intensive care. The training program evolved to provide subsequent trainees with a broader base of knowledge, skill and technique.

The paramedic personnel, having been trained in a major medical facility in their first occupational encounter with the health care field, came to rely on the availability of medical skills and disciplines to be found in a teaching institution. They took for granted the fresh knowledge of interns and residents at Harbor General. They presumed that every emergency care facility could and would muster immediate and competent personnel, equipment and resources in every life-threatening emergency situation. The relatively unplanned approach had not included a planned upgrading of satellite emergency facilities or selective exclusion of deficient facilities.

The American Medical Association's "Recommendations of the Conference on the Guidelines for the Categorization of Hospital Emergency Capabilities" was not released until 1971. Nearly two years prior to that event, the new paramedics of Los Angeles County unwittingly began to engage in episodic categorization without benefit of guidelines. The County of Los Angeles contracts with more than 100 hospitals to provide emergency room services to citizens requiring such care. In keeping with that contractual arrangement, the paramedics were required to deliver their treated and stabilized patients to the nearest contract facility, although they received radio transmitted instructions and authorizations from Harbor General.

To the newly-certified paramedics, bristling with esprit de corps and determination to bring their entire capabilities to the saving of a life, the reality that some of the contract facilities and staffs lacked that determination was unacceptable. With what appeared to some as self-righteousness, the paramedics did not restrain their

criticism of doctors and nurses who had forgotten the techniques of basic life support. With little inclination toward tact, they were openly critical of hospitals which were not equipped nor staffed to carry through with the stabilization which they had accomplished in the field.

An aggressive and vigorous assault is the appropriate problem-solving methodology in the field of fire fighting. Such an assault by the firemen-paramedics on the hospital problem produced little more than mutual hostility. As an alternative to delivering patients to hospitals which they deemed ill-prepared or improperly staffed, the paramedics commenced the process of episodic categorization, taking patients past the contract hospitals to their familiar and reliable home base at Harbor General.

A carefully planned approach to the paramedic program might have anticipated the contract hospital problem in advance of implementation - but solution would have been doubtful. To most of the smaller hospitals, the emergency room was an unattractive nuisance. Greater financial commitment to improvement of emergency services was at the bottom of the priority lists. Only a crisis would generate the attention necessary to solve the problems. The interhospital rivalry and commercial interests that were generated by the unofficial paramedic categorization raised the necessary crisis atmosphere.

A carefully planned approach to the program would have included committee decisions on a choice of personnel to participate in the paramedic program. Because of their vehicular inability to transport patients, the rescue firemen would have probably been overlooked in the choice. A planned approach might have viewed vehicle configuration as more important than such intangibles as maturity, career orientation, trainability and stable judgement in serious emergency situations.

Dr. Criley's choice of personnel was initially economic. He could obtain the services of career firemen without any direct costs to his program. The fire department was willing to relieve the personnel from fire protection duty during the five-month training period. A choice of local commercial ambulance personnel at that time would not have included the economic advantages nor the intangible personal qualities.

A carefully planned approach might have attempted to build cooperation and rapport between the commercial ambulance attendants who would ultimately transport their patients. By contrast, the ambulance personnel and their employers

viewed the paramedic program as a threat. There was strong suspicion that the program was a prelude to governmental takeover of commercial ambulance services.

The immaturity which would have made the commercial ambulance personnel of the era a poor choice as trainees surfaced as the paramedics became operational. Disruption of the paramedics and sabotage of their equipment and supplies were among the symptoms confronted by the program in its early days. Once again, the crisis orientation mobilized the political power base in search of a solution. Given the history and human dynamics involved in this people problem, no amount of advance planning and conference would have produced a sufficient commitment to cooperation in advance of implementation.

Among HEW's fifteen recommended objectives for an EMS system is the topic of consumer education and information. HEW's 1974 Planning Outline for use in developing a Comprehensive EMS Plan likewise refers to consumer education. Consumer education and information was not planned in the initial development of the Los Angeles County paramedic program. Once the first unit had become operational, some of its more dramatic and successful cases found the interest and coverage of the local press. Other than this episodic and happenstance exposure, there was no planned or programmatic endeavor to educate the public concerning medical emergencies or the services available to them.

On May 11, 1971, as the first two units were operational, a grant application was being prepared to seek National Highway Traffic Safety Administration funds for training of a third unit. It was on that day that television producer Jack Webb made contact with the Los Angeles County Fire Department concerning a vague idea for a television series concerning rescue. Subsequent months of joint effort between the fire department, the county's health agency, Harbor General Hospital and the Webb organization attempted to produce a series format which would entertain as well as educate.

There can be little valid argument with those who contend that the "Emergency!" television series was more inclined toward entertainment than consumer education. Nonetheless, there can be little argument that national media exposure of a new concept in prehospital care had phenomenal impact on public expectations and demands. Nowhere was that impact more obvious than in Los Angeles County.

As Los Angeles area residents saw the embryonic paramedic

program depicted in a prime-time entertainment medium, they began to ask why it was not available throughout all parts of the county. They wanted to know why a few residents of a limited geographical area had access to a desirable service that was not available to all. The political patron of the paramedic program picked up the cue. Pressure and demands for expansion began to build. That pressure and those demands did not include a logical plan for developing a communications system which could support the more than 100 units projected for the future.

In the early stages of the pilot program, radio frequencies were licensed to participating hospitals. There was no intermediary control facility or system. A noble effort was spearheaded by a local representative of the International Municipal Signal Association (IMSA) to coordinate the frequencies by separating them geographically. The effort worked for a few months.

By early 1972, two new units were being implemented every five weeks. A second training facility had been opened at L.A. County - U.S.C. Medical Center to quicken the pace of expansion. New paramedic units were being assigned to locations according to political imperatives, rather than valid health system priorities. The effort to coordinate frequencies by geographical separation was being strained as paramedic units suffered cross-county interference on a daily basis.

Confronted with the growing problems of hasty and unplanned implementation, and the absence of a radio communications system, County government appropriated \$50,000 to the County Department of Communications for a study of the problem. The funds remained untouched in the subsequent 18 months as the communications bureaucracy wallowed in indecisive inertia. In the meantime, 30 new paramedic units became operational.

The flat and treeless Los Angeles basin presents optimum propagation circumstances for the portable UHF (ultra high frequency) transceivers being used by the paramedics. Signals from a Hollywood unit came in on distant Lakewood. Tests at two watts in each produced a loud and clear signal in the foreign sections of Orange County - also joining in the paramedic implementation movement.

A system implies organization, preplanning for a variety of circumstances, and coordinated functioning of a multiplicity of operational elements. As frustrated paramedics began to "shop" the spectrum for a clear channel and a dis-

tant and foreign hospital to provide them with authority and direction, it became obvious that Los Angeles County was totally absent a communications system.

1974 produced some bright indications of progress from the growing darkness of communications chaos in Los Angeles County. The dream that had begun with comfortable intimacy and manageable size in 1969 had achieved Department status in the County's giant health services agency. A capable Director had been appointed with adequate authority to begin the long and complex problem-solving tasks. The \$50,000 had finally been committed to an initial "parameters" study of the communications problem. Importantly, the FCC had devised a rules structure that could facilitate a systems approach to medical communications.

Those responsible for the now-vast Los Angeles County EMS system face some formidable planning and implementation tasks. If the communications planning calls for a fully-managed medical communications system, as envisioned by the FCC rules, there will be a need for political negotiation in selecting the appropriate base or agency for such system management.

The evolved paramedic program is now part of an EMS system and utilizes the personnel resources of both fire departments and commercial ambulance services. Despite the homogeneous appearance of greater Los Angeles, parochialism continues to dominate the judgement of many of its public service agencies and organizations. An interagency spirit of cooperation will be essential in developing the "common system" approach to medical communications anticipated by the FCC. Anything less would perpetuate an imperfect system exemplified by frequency shopping, interrupted transmissions and inadequate medical supervision.

A discussion of events in Los Angeles may not be entirely appropriate to a Conference on Remote EMS. There is little remoteness to be found in that California mass of humanity. But there is no one so remote as the Los Angeles paramedic who needs advice, confirmation, authority, assistance or assurance in managing a life in the balance - if he is operating in a crowded communications nonsystem.

Though this treatise may present contradictory impressions concerning the concept and discipline of planning for an EMS system, it should be recognized as an historical account and reflection of the human realities involved in such an effort. If the instincts, goals, and impulses of the human elements cannot be preprogrammed, any blind reliance on a planned approach to implementation must be

viewed as a gamble.

Criley, Nagel, Cobb, Warren and other pioneers in prehospital care could easily have been dubbed as gamblers. In a way, they were. With the advantage of hindsight, we can see that many of the problems encountered by their projects and programs might have been avoided with serious and protracted planning. But it is also clear that much of the success of the Los Angeles County system would have never occurred if the process had been retarded or halted for the luxury of time to plan.

The pioneering chance and boldness of 1969 is but a mere six years behind us. In revolutionary times, six years can be equated to a generation. Improvements in prehospital care and transportation since 1969 have been little less than revolutionary. It is now a new generation. The lessons learned by the pioneers are now available for the benefit of the current generation of implementers. Current public and political expectations present a totally new set of odds.

One of the major goals of health system planning is risk avoidance. Many of the risks were unknown in 1969. The icy waters had to be tested by those with the fortitude to take a chance. That fortitude and the resultant experience should be serving us well.

The opportunity to pioneer is a rare experience, seldom to be repeated. Those who would seek to plunge into EMS with unplanned boldness in the current age should be judged as cavalier. The current generation of EMS policy-makers has the opportunity to avoid risk. It has an undeniable obligation to engage in system planning as the appropriate method of minimizing risk.

With adequate planning, the work of the pioneers can be honored by making EMS something more than a short-lived health system fad. With adequate planning, EMS will become a vital part of the total health care system. But adequate planning must be recognized for what it is - a tool and not a sacrosanct end product.

SATELLITE-AIDED BIOMEDICAL TELECOMMUNICATIONS

Richard B. Marsten, Ph.D.

INTRODUCTION

In 1967 and 1968, the National Academy of Sciences conducted a study on useful applications of earth-oriented satellites for the National Aeronautics and Space Administration. Several forms of satellite-aided biomedical communications appeared among the more promising applications suggested by the Broadcast Panel of the study.¹ The Lister Hill Center for Biomedical Communications of the National Library of Medicine became interested in the use of satellites for providing professionals rapid access to widely separated sources of medical information and for interconnecting hospitals, health centers, and medical libraries. The potential for delivery of health-care to remote areas not enjoying ready access to health services was also recognized.

Discussions were opened with NASA in 1969, shortly after NASA's announcement in June that communications capabilities of its Applications Technology Satellites (ATS) were being made available to organizations interested in experimenting with new applications of satellite communications to serve their own needs. Together with the Public Health Service, the Lister Hill Center proposed a series of experiments in the delivery of health care to isolated, rural populations using ATS-1. The experiment embraced some 26 villages (Figure 1), most of which were in the Tanana Service Unit of Alaska, a region about the size of Texas with only 10,000 people, including the Tanana Base Hospital. ATS-1 linked these villages with the Tanana Hospital, the hospital in Anchorage, and the National Library

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1. Useful Applications of Earth-Oriented Satellites: Broadcasting; Report of Panel 10, Summer Study on Space Applications, National Academy of Sciences. Washington, D.C., 1969.

Director, Communications and Data Management Programs
National Aeronautics and Space Administration
Washington, D.C. 20546

of Medicine in Bethesda, Maryland. ATS-1 could provide two-way voice service over the entire area of experimentation, operating in the very-high-frequency bands allocated to space research. Simple, inexpensive earth stations were provided by the experimenters at each village and at the participating health centers (Figure 2). The satellite was made available one to two hours a day, five days a week for teleconferences between the native health aides, who have up to 16 weeks' training by the Public Health Service, and the health professionals at the participating health centers. Communications between health aides and professionals at the centers was used for description of symptoms, diagnosis, and prescribed treatment. Satellite capacity was also made available for medical emergencies.

The initial year of activity, 1971-72, showed a statistical increase in radio contacts via satellite of about 400 percent compared with high-frequency radio contacts prior to installation of the VHF satellite earth stations. This improvement in technical performance was not surprising, since even at VHF the satellite links are relatively immune to the blackouts that plague HF transmissions. But with the technical performance came a corresponding increase in discussions with physicians. The terrain and climate that made high-frequency radio service irregular at best and sometimes prevented contacts between health aides and physicians for a week or more had been largely overcome with satellite radio links. Both health aides and physicians are convinced that regular, daily consultations have improved the quality of health care and that, in fact, the satellite is responsible for several lives having been saved in emergency situations.

Initial results led the Lister Hill Center and the Indian Health Service to propose additional experiments on ATS-1, while the experiments in remote-site health-care delivery continued. For example, nurses in small clinics throughout Alaska "attended" a three-month course on coronary care, and the University of Washington School of Medicine attempted transmitting lectures in basic science to students at the University of Alaska. Results, including the ability to get satellite coverage for medical emergency situations, were successful enough that the Health Resources and Health Services Administrations of the Department of Health, Education and Welfare decided to cooperate with the Lister Hill Center in advanced experiments on ATS-6. The continuing success of the ATS-6 experiments, in turn, has led experimenters to propose still broader investigations into satellite-aided biomedical telecommunications on the Communications Technology Satellite (CTS), a joint development of NASA and the Canadian Department of Communications, scheduled for launch at the end of 1975.

SATELLITES, EARTH STATIONS, AND EXPERIMENTAL NETWORKS

ATS-1, launched in December 1966, is a spin stabilized spacecraft (Figure 3) in a synchronous-altitude orbit at 147° West longitude in the equatorial plane, over the Pacific Ocean. It can

support a single voice link in the experimental, space-research band at 149 and 135 MHz, using earth stations like that shown in Figure 2. The helical antenna, about seven feet long, is connected to a commercially-manufactured mobile radio transceiver. The entire installation costs less than \$3000. Alternatively, the satellite could support a single voice link in the commercial satellite communications band at six and four GHz, using more complicated earth stations consisting of 15-foot-diameter, reflector antennas and much more sophisticated electronics. Such stations could cost \$25,000 each. Finally, the satellite could support a single television link at six and four GHz using stations comparable to those in commercial service: 30-foot or 42-foot diameter antennas with still more sophisticated electronics to accommodate the TV, at a station cost exceeding \$125,000. For any of these links, ATS-1 provides coverage over about 45 percent of the earth's service (Figure 4).

The next step in advancing technology was to make possible television transmission to simple, small, low-cost ground stations. This objective was beyond the scope of the first series of ATS spacecraft; it was first addressed in ATS-6. It could be achieved by increasing power in the spacecraft, or by increasing antenna size, or by a combination of both. Increases in antenna size concentrate the beam and thus reduce the available coverage area, but have the effect of increasing radio power without requiring corresponding increases in real power on the spacecraft. Weight limitations associated with power increases tended to resolve the design toward a large antenna. Accordingly, ATS-6 (Figure 5) was designed with a 30-foot-diameter antenna and power sufficient to work either of two television channels with simple, low-cost earth stations. In the Instructional Television Fixed-Service band at 2.5-2.69 GHz, ATS-6 can support two television channels, each having four associated audio channels, with earth stations like those shown in Figure 6. The antenna, a 10-foot-diameter reflector with receiving electronics integrally mounted, is fixed in position and requires no adjustments; the indoor unit is equipped with an ON-OFF switch, a pilot light, and a signal strength meter to indicate satisfactory reception or signs of trouble. These stations cost under \$4000 installed. Each station feeds a conventional TV receiver. System tests have shown the picture quality to meet the specification of 49db signal-to-noise ratio: at least as good quality as that customarily seen on TV studio monitors.

ATS-6 is the most powerful, complex, versatile communications satellite yet launched. As the Applications Technology name implies, it carries many experiments. The Health/Education Telecommunications (HET) experiment at 2.5-2.69 GHz, which contains the experimental activity in biomedical communications, is only one of 23 varied experiments in space technology, meteorology, space science, communications sciences, and communications applications. Consequently ATS-6, as an "experimental bus", represents a design compromise to obtain maximum return from all its experiments and is not optimized

for any particular one. This must be kept in mind when facing the necessary transition from experimental demonstration to operational service, even though the HET experiment be widely regarded as the principal application experiment the spacecraft carries, consistent with its principal technical objectives.

Launched May 30, 1974, ATS-6 was placed in a synchronous-altitude, equatorial orbit at 94° West longitude. During its first 30 days in orbit it achieved its principal technical objectives: unfurling the 30-foot-diameter antenna structure and demonstrating ability to provide a good-quality TV signal to the small, low-cost ground receivers; stabilizing the spacecraft using three-axis control techniques; and demonstrating precision pointing of the antenna to prescribed areas of coverage. Since then, it has supported a very successful series of applications experiments. Those in health care include a program of medical information exchange among hospitals of the Veterans Administration in the Appalachian Region, expanded activities in telemedicine in Alaska using television as well as voice, professional medical instruction and education in the states of Washington and Alaska, and recertification training for emergency medical technicians in the Federation of Rocky Mountain States. The coverage provided by the satellite at 2.5-2.69 GHz for these experiment components is shown in Figure 7. The satellite covers each north-south region in turn for its particular experiment activities, and can broadcast either the same TV channel on both beams or separate channels, one on each beam.

ATS-6 capabilities are limited to one-way broadcasting, but all of the health experiments are interactive. Because ATS-1 and ATS-3 both have two-way voice capability, it was decided to use them for interactive voice backup to ATS-6 transmissions in the experiments. Once the effectiveness of the health-care services being explored was demonstrated, it would become clear that an operational service derived from experimental results would have to have video and voice capability in a single satellite. Based on these considerations, three kinds of ground stations were made available for health experiments: receive-only terminals, intensive terminals, and comprehensive terminals.

Receive-only terminals are as pictured in Figure 6. Each could receive either of the two video channels available from the satellite. Intensive terminals are receive-only terminals augmented with two-way voice transmitters like the VHF terminals of Figure 2, to work through ATS-1 and -3 for interactive voice communication. Comprehensive terminals, permitted because of radio-frequency interference considerations on a one-time basis at selected sites in Alaska and Washington only, are intensive terminals augmented with full video transmission capability at 2.25 GHz. The Veterans Administration hospitals were equipped with receive-only terminals, and relied on telephone lines for interaction and slow-scan transmission of visual materials. Four sites in Alaska and one at Omak, Washington are equipped with comprehensive terminals. In the Federation of Rocky

Mountain States, 24 sites are equipped with receive-only for health experiments. Receive-only sites will use telephone lines for interaction.

ATS-6 earth stations are designed to meet the needs of the education and health-care communities using them. Detailed specifications were written jointly by the Lister Hill Center, NASA, and the Federation of Rocky Mountain States. It was intended from the outset that the stations would be operable solely by health personnel and teachers, and that technician services would only be required for periodic inspection and maintenance. The equipment is simple, solid-state throughout, with relatively few circuit boards so that first-level maintenance is readily accomplished by plugging in substitute boards until the defective one is found. There are no high voltages, and only a single switch and indicator for operation. The adjustable mount on the three-meter, parabolic antenna is designed as a one-time adjustment for a particular installation.

Figure 8 gives a schematic overview of the networking arrangements for HET. Satellites are controlled from NASA's ATS Operations Control Center at the Goddard Space Flight Center in Greenbelt, Maryland. Transmissions to and from the satellites, as directed by ATSOCC, take place from NASA's ATS earth station complex at Rosman, N.C. For HET transmissions, experimenters may have access to the satellites from there or from the HET National Communication Center at Denver, Colorado. Connections between ATSOCC and NCC are by telephone lines. Other experimenters may contact NCC directly by telephone or through ATSOCC. Once on the satellites, the interactive voice links may be used. Table 1 gives characteristics of those HET links used for biomedical communications.

ATS-6 was intended to operate for approximately a year at its station at 94° West longitude. About the middle of May 1975, it was to move to a new location at 35° East longitude, over Lake Victoria, where it would be used to support a year-long experiment of the Indian government in instructional television. In July 1976, it will be returned to a position over the United States, where it will again be available to interested experimenters.

In developing the HET experiment and its underlying technology, NASA and the Department of Health, Education, and Welfare cooperated in achieving the joint objective of opening up the 2.5-2.69 GHz band of the spectrum to satellite broadcasting. This band and a larger one at 11.7-12.2 GHz were allocated to satellite broadcasting services by the 1971 World Administrative Radio Conference of the International Telecommunications Union. NASA has also pursued the technology for demonstrating satellite broadcasting in the higher-frequency band. The CTS mentioned in the Introduction will operate in this band.

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CTS will carry a high-power, broadcast transmitter, and so can use a smaller antenna than does ATS-6 for the same signal intensity. Where ATS-6 transmits 15 watts per broadcast channel, CTS transmits 200. The effect of this is to reduce the antenna required from the 30 feet of ATS-6 to about 2.8 feet for CTS. This increases the coverage provided by CTS' single, TV-broadcast beam to about 1/3 of the continental U.S., as shown in Figure 9. The satellite itself, shown in Figure 10, is three-axis-stabilized like ATS-6, but has two, pointable antennas that can be focused on the regions of interest for transmission to and reception from the spacecraft. One antenna receives, the other transmits, the single television channel the satellite can handle.

CTS, too, is equipped to handle four channels of audio with the television. It is designed, however, to accommodate interactive voice transmissions within its operating band. It can accommodate up to 26 interactive voice channels along with its video-and-audio broadcast channel, and so is self-sufficient for interactive experiments. No auxiliary satellite is needed.

Low-cost ground station technology is also being developed for CTS user experimenters. Because radio waves at 12 GHz suffer losses when traveling through rain, and because technology at higher frequencies is more complex than the corresponding technology at lower frequencies, CTS ground stations will, at first, be more expensive than those for ATS-6. Present estimates for receive-only terminals at 12 GHz are at about \$12,000 in quantities of 100 to 200. But the larger bandwidth available around 12 GHz means that more capacity for service exists here than at 2.5 GHz, and as experiments evolve into services the aggregated traffic may suggest operational advantages that could be realized at the higher frequencies. While that remains to be seen, user interest in experiments on CTS gives early indication that the development of satellite broadcasting technology at 12 GHz was needed. The Lister Hill Center, the Veterans Administration, the Washington-Alaska-Montana-Idaho (WAMI) Program of the University of Washington School of Medicine, and the Association of Western Hospitals are all developing health-care experiments for CTS.

The remainder of this paper will review the Veterans Administration, Alaskan Telemedicine, and WAMI ATS-6 experiments. The VA and WAMI plans for CTS will also be summarized.

VETERANS ADMINISTRATION (VA) EXPERIMENTS

The VA operates 171 hospitals. About 160,000 veterans daily receive medical care in a VA hospital or clinic, or in a nursing home or domiciliary. VA costs for health care amount to nearly nine percent of the nation's total hospital bill.

The VA has requirements for remote practitioners to have access to consultation from specialists and for providing interactive training programs to professionals and paraprofessionals throughout its complex without incurring excessive transportation costs and

without attendant loss of work time. Satellites could offer cost-effective solutions to these requirements. To test the efficacy of satellite communications, the VA has selected ten hospitals in the Appalachian Region to participate in a series of professional enrichment and in-service training programs. Participating hospitals are listed in Figure 11, which shows the associated region of VA service within the ATS-6 coverage area. Experiment activities have been under way since August 1974.

Hospital staffs have participated in educational and teleconference programs related to clinical problems experienced with hospital patients. Transmissions have been running regularly at about 2-1/2 hours per week. More than 50 topics have been presented, directed to target audiences including physicians, dentists, registered nurses, licensed practical nurses, nursing assistants, and patients and their families. Five formats have been used, depending upon the subject matter and target audience:

- * Video seminars, broadcast from Denver, with groups at the participating hospitals asking questions and commenting over the return audio channel.
- * Patient case presentations televised from one hospital to all the others, with audio return enabling viewers at all 10 sites to participate.
- * TV teleconsultation, with physicians at VA hospitals consulting with specialists at teaching institutions. Patients and clinical material may be televised.
- * Computer-assisted instruction, with physicians and staff personnel participating in programmed instruction mediated by computer. Subject material includes history-taking, diagnosis, and management of clinical problems.
- * Slow-scan transmissions, using narrowband signals; including such items as electrocardiograms and X-rays. To eliminate waiting time, slow-scan material is transmitted prior to each teleconsultation broadcast and stored on videodiscs. Both black-and-white and color have been used in such transmissions. The experiments are exploring uses and limitations of such transmissions in consultations and diagnosis.

Film and videotape portions of the programs were developed by the National Medical Audiovisual Center in Atlanta, while live broadcasts originated from Denver. Program topics were selected by the 10 participating hospitals, who were required to designate target audiences and list training objectives for each program. Medical schools throughout the Appalachian Region (and outside in several instances) were advised of the project and invited to participate

by providing faculty for programming of specific topics. These specialists, and other consultants as appropriate, were available in the broadcasts studio and appeared the telecasts to participating hospitals. They were visible and available to the audience in the interactive and consulting portions of the transmissions.

The VA is especially interested in objective evaluation of its experiments, and has engaged an independent firm to evaluate the efficacy of its uses of satellites for biomedical communications. This evaluation was not completed, nor were preliminary results available, at the time of writing.

The VA project coordinator has reported, however, that the experiment series has been virtually free of technical difficulties except for a few instances in the first few weeks, before the operating engineers and program participants became accustomed to the equipment and the format for broadcasts. Perhaps the best early indicators of overall success in achieving the program objectives of demonstrating effective, widespread, in-service training and timely, useful, concise information to specialists originating teleconsultations are the professional accreditations earned by the VA programs. All physician-oriented programs have been approved for Category I credit (one credit per hour) by the American Medical Association when presented in a formal learning situation.² The Pennsylvania Nursing Association has approved the programs for continuing education credit for nurses (one hour for 0.1 continuing education unit). The American Dietetic Association has approved 28 individual programs in the series for credit.² It appears that many successes, as well as identification of some things that should be done differently or better, are resulting from the VA experiments.³ The VA experience has led it to extend its experimental program planning to CTS and to indicate its intention to join in the attempt to obtain operational services through the Public Service Satellite Consortium.

The VA regards CTS as a logical second step for extension of potentially successful communications links demonstrated by ATS-6, both in scope of services and in geographical coverage. With the ability of CTS to support two-way television, the capability for experimenting with a much wider range of interactive health-care services can contribute significantly to determining the cost/effectiveness of satellite-aided biomedical telecommunications. And with the extended geographical coverage, more hospitals can be

2,3. UPLINK: News About the Veterans Administration Health Communications Experiment on the ATS-6 Space Satellite.
Vol. 1, Number 4, October 1974; Vol. 2, No. 1, January 1975.

included so that findings will be relevant to operations over the entire VA hospital net. Expanded coverage will provide a more effective, widespread teaching and operating experience with telemedicine to health-care personnel and patients alike.

Accordingly, the VA plans to link 30 hospitals in remote locations for the new series of experiments. Utilization seminars will be conducted among experimental hospitals. Independent organizations will again be contracted to perform evaluations of the experimental programs. In addition to exploring the use of two-way video/audio for providing information and education to physicians, nurses, allied health personnel, and patients beyond the ability of one-way video and two-way audio, teleconsultations will be conducted and grand rounds will again be made with satellite-connected attendees. The advantages and limitations of interactive audio compared with video will become clearer with this series of experiments.

Experiment activities would demonstrate normal use of satellite communications as a standard health-care tool, providing timely information in a format most accessible to health personnel located in remote hospitals and to validate cost-effective, innovative uses of the technology in health-care situations involving many, widely-separated institutions. The results would provide a basis for planning to assure that operational satellite broadcast services for health care will be available in the future.

TELEMEDICINE IN ALASKA

Although reliable voice consultation enhances the Alaskan village health aide's services, many situations require more than words to provide enough information to the physician about the patient. Delays in diagnosis, and in some cases unnecessary evacuation, could be avoided if visual information were available. The ATS-6 Alaskan experiment in telemedicine has established the effectiveness of video telemedicine in this context.

The experiment was conducted at five sites in Alaska. Clinics at Fort Yukon (pop. 630) and Galena (pop. 425), the Public Health Service Hospital at Tanana, and the University of Alaska at Fairbanks, were all equipped with comprehensive terminals. Examining rooms were each provided with a simple black-and-white TV camera, a video recorder, microphone, and speakers to work with the terminals. Consultation was provided from Fort Yukon, Galena, and Tanana with specialists at Fairbanks and the Alaska Native Medical Center at Anchorage. The latter was equipped with an intensive terminal.

Actual operations began with the Tanana physicians calling the villages and clinics on ATS-1 to discuss their problems, as

they had done for the preceding two years. Patients thought to need visual consultation would be scheduled for ATS-6 time. Prior to being "seen" by the doctor, the patient's records would be retrieved, via ATS-1, from the Indian Health Service's Health Information System computer store in Tucson, Arizona. With the records available, the physician at Tanana would "see" the patient and prescribe therapy. During his examination, he could have physiological information (e.g. EKG, heartbeat, pulse) sent simultaneously on one of the four audio channels available with each ATS-6 video channel. Talk-back to the presenting clinic was accomplished on ATS-1, since ATS-6 cannot accommodate two-way operation. When he thought it necessary, the physician at Tanana would call in specialists from Fairbanks or Anchorage to "see" the patient. After the "visit", the physician would transmit his report via ATS-1 to the patient's medical record in Tucson.

To preserve privacy between patient and physician, scramblers were provided for all comprehensive transmissions. Descramblers were available only to the presenting clinic and consulting staffs. This has worked extremely well: patient confidence in the entire telemedicine examination process is high, and the picture quality is not impaired by the scrambling-descrambling process.

Helen Christy Cannon, M.D., a pediatrician, nutritionist, and telemedicine expert in Anchorage, assessed the project as follows: ". . . the first experiment in health care delivered to a population on earth by satellite television broadcasting. . . . During a recent period of several weeks, when aircraft could not fly due to the extreme cold, Fort Yukon . . . had to rely totally on video and audio communications. The video proved to be very effective in this crisis situation, and the citizens of Fort Yukon and the health team were highly gratified by the life sustaining services it made possible . . . The specialists have expressed satisfaction with their ability to diagnose confidently and to recommend and direct treatment with the aid of satellite television. The trained specialist can answer many important questions by seeing a patient rather than simply having a second-hand description . . . visual clues come through clearly on satellite television and contribute vital information for the management of patients."⁴

There have been numerous experiences showing that some, if not all, of the Indian Health Service's objectives in this experiment are being met. Since September, over 100 tele-consultations have been made in which serious illnesses and complications have been shortened and lives have been saved.⁴ The Honorable Caspar W. Weinberger, Secretary of Health, Education, and Welfare, has cited examples of the effectiveness of satellite telemedicine in patient crisis

4. Statement of Helen Christy Cannon, Medical Officer, Alaska Area Native Health Service, Indian Health Service, before the House of Representatives Committee on Science and Technology. Washington, D.C., February 5, 1975.

care, in preventive medicine, in accurate diagnosis without need for evacuating the patient, in group clinical medicine and patient education, and in in-service training of health personnel.⁵ Summarizing the Indian Health Service experience in telemedicine, the Secretary said:

"So successful have satellite-delivered services been in Alaska, that the Alaskan Federation of Natives--a highly representative, grass-roots organization--has made it the top priority for their people. Their goal is to achieve an operational satellite service for health, education, and other communication needs. The State is energetically pursuing that goal through a variety of approaches, including active membership in a satellite consortium."⁵

HEALTH EDUCATION AND CLINICAL MEDICINE

The University of Washington School of Medicine, in Seattle is the only school of medicine in the four states of Washington, Alaska, Montana, and Idaho. All four states rely heavily on that school for medical education. The school has had a successful and growing program in regionalized medical education under way since the fall of 1971 in an effort to provide that education without a huge capital expenditure for new facilities and without taxing out-of-state or out-of-town students unduly by requiring them to spend four years in residence at Seattle.

The program, in cooperation with outlying university in the WAMI region, has students acquiring their initial basic science training at universities in their home states. They complete the basic medical training--at least the second full year of medical school--at the University of Washington. Then they return to their local communities, where they acquire their clinical training under the preceptorships of selected physicians working with the University of Washington. Approximately 121 students have begun their medical education at WAMI universities, and 212 have completed community clerkships in family medicine, internal medicine obstetrics-gynecology, pediatrics, or psychiatry.⁶

Interactive television by satellite offered an innovative means of delivering off-campus instruction with the flavor of immediacy of contact with the School of Medicine faculty. WAMI is using ATS-6 to explore the potential of formal medical education delivered by the faculty to students throughout the region. Such interaction

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5. Remarks by the Honorable Caspar W. Weinberger, Secretary of Health, Education, and Welfare; American Institute of Aeronautics and Astronautics, National Meeting, Washington, D.C., February 26, 1975.
 6. ATS-6 HEALTH EXPERIMENT. Phase I: Planning and Development University of Washington report under contract NIH-CG-2003. Seattle, Washington, December 1974.

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with full range of specialists available at the School of Medicine would increase the feeling of contact with the centers of modern medicine on the part of students in remote areas. It could also be used for more effective administration and coordination of the WAMI program.

In the "University phase" of the curriculum experiments, basic science lectures and demonstrations are being presented to a class of first-year medical students at the University of Alaska, in Fairbanks. This phase of the experiments, active since September 1974, employs full-duplex video and audio, allowing students and instructor to have full view of one another during class sessions (Figure 12). It offers an opportunity to test whether sufficient faculty-student interaction occurs by two-way television to have effective basic-science education. Seventeen lectures have been broadcast to students at the Fairbanks, Alaska campus, originating from the Health Sciences TV studio at the University of Washington School of Medicine (Figure 13). Broadcast take place at 9:50 am Thursdays.

In the "clinical phase" of the curriculum experiments, ATS-6 links the Family Medical Center in Omak, Washington with Seattle on Tuesday mornings. Four types of transmissions have been employed. At the beginning of each clerkship, Seattle faculty briefed Omak faculty on the clinical experience of arriving students. Subsequently, Omak faculty described specific problems they were having in educating their students in clinical settings. Third- and fourth-year students in Omak gave regular case presentations to Seattle faculty for evaluation. And the Seattle faculty made chart rounds by satellite link to evaluate students' record-keeping skills. The two-way video/audio link was also used for residents to present cases or special projects to the Seattle faculty.

WAMI experiments in faculty and paraprofessional education included five types of transmission. Nurses and other staff in Omak defined roles and procedures in a rural setting to a Seattle audience; later, Seattle paraprofessionals reciprocated for those in Omak. Pathology technicians demonstrated the latest laboratory techniques and provided consultations for technicians in Omak. Seattle faculty lectured to Omak on topics in radiology and pathology; Omak faculty, on such topics as "Emergency Medical Care in a Rural Setting" and "Problems of Family Practice Management". The faculty coordinator in Seattle for family medicine conducted televised rounds in Seattle to demonstrate his methods of teaching for Omak faculty. And consultations for Omak physicians and residents were made available throughout the year. In addition, satellite-linked mental health consultations were held on a number of Tuesday mornings between the Department of Psychiatry in Seattle and the Okanogan (Washington) Mental Health Clinic. Consultation and discussions were also held with Alaskan installations on topics such as dermatology and endocrinology.

Telecasts from Omak originated from Mid-Valley Hospital, and were half-duplex video with full-duplex audio. Thus Omak could send or receive video, but could not do both simultaneously.

Full-duplex audio capability was achieved by using the ATS-1 voice link in addition to ATS-6.

In addition to experiments in education and training, WAMI activities included experiments in student guidance, computer-aided evaluation, and administration. The student guidance experiments touched on pre-medical counseling for University of Alaska undergraduates, admissions interviews between Alaskan candidates and the Admissions Committee, and counseling of Fairbanks students to try to diminish both their sense of isolation and their anxiety over the equivalence of their own classroom experiences with those of Seattle students. Computer-aided evaluation experiments made it possible for the first time for Fairbanks students to interact with instructional and testing programs at Seattle. This makes independent study programs available to Fairbanks students while providing another mechanism at Seattle for monitoring their progress. Remote evaluations of this kind, and as obtained throughout the duplex-video transmissions, were supplemented in every six-week period by on-site faculty visits for the clinical and curricular experiments. Such visits made comparisons possible between satellite-aided education and traditional forms.

Finally, WAMI experiments in administration included program coordination, faculty conferences, and administrative procedures. Faculty meetings via satellite video teleconference formed regular segments of each week's broadcast time of three hours (Figure 14).⁷ These 25-minute meetings, usually following a 50-minute class period, were used to improve administrative procedures, cut down paperwork, and coordinate course offerings. In practice, they also provided opportunity for on-the-spot, ad-hoc evaluations of presentation practices that could improve subsequent sessions.

The University of Washington is engaged in detailed, formal evaluation of the ATS-6 experiments. Although results are not yet available, early indications were sufficiently encouraging to justify expanded experimentation on CTS. The curricular experiments would be expanded beyond those of ATS-6 to include participating faculties and students at Bozeman, Montana; Moscow, Idaho; and Pullman, Washington. The transmission of entire courses is being considered. Students at participating community clinical units could have their experience enhanced by participating in grand rounds via satellite. This new addition to the clinical phase of the experiments could greatly increase rapport between students at remote, clinical sites and the School of Medicine faculty. And the satellite would be used for more realistic evaluation of students progress and ability by having them transmit patient workups to the faculty.

7. WAMI NEWS, Vol II, No.6; November/December 1974.

Administration experiments would be expanded by making attendance at Class meetings available to students to remote universities via satellite, by allowing WAMI program coordinators at participating universities to meet more frequently and conveniently, and by having regular curriculum planning conference via satellite. And professional/paraprofessional activities in continuing education would be expanded, both to include "Days of Medicine" conferences on special topics such as hematology/oncology and nephrology and to conduct conferences and consultations around medical audit studies. Here, community clinical units and the University medical center would use two-way audio with one-way (and occasional two-way) video to discuss development of criteria for clinical problems. Follow-up educational programs based on audit results could be conducted by video.

EVALUATION AND FOLLOW ON

It is NASA policy to require all "user experimenters" in the ATS programs to propose, plan for, and conduct a formal evaluation of their experiment results. This evaluation should not just address a comparison of results obtained with results anticipated, but must also assess the applicability and utility of the experiment activities and their results to the provision of regular, continuing services. As indicated earlier, all the experimenters in biomedical communications are engaged in such evaluations. These will be reported formally at an international conference on communication satellite for health/education applications in July 1975.⁸

Further, experimenters must recognize that experiments in new applications of satellite communications can be supported by NASA only for limited periods. As the services explored and supported by such experiments expand, the experimenters must look to franchised commercial entities to provide them on a continuing, operational basis. Part of the evaluation reporting, consequently, is expected to address planning for follow-on activities in terms of transition to operational services. Health-care experimenters on ATS-6 and CTS have recognized this need, and are developing their projected service requirements. During the transition period, the experimental activities continue to demonstrate the potential of satellites to support national, biomedical communications services and to enhance delivery of health care and health education to the people. Their impact has contributed substantially to interest expressed by many segments of the health-care community in the translation of

-
8. Conference on Communication Satellites for Health/Education Applications, co-sponsored by the American Institute of Aeronautics and Astronautics, the Joint Council on Educational Telecommunications, and the Veterans Administration's Department of Medicine and Surgery. Denver, Colorado: July 1975.

experiments to public services through their participation in activities leading to the formation of an organization to provide such services.⁹

9. Public Service Satellite Consortium, Inc., Washington, D.C.

TABLE 1
HET OPERATIONAL RESUME

	VA	FRMS	WAMI	AK-HEALTH
Terminals: Uplink		1		
Receive Only	11	44		2
Intensive (2-way voice)		24	3	3
Comprehensive (2-way voice and TV)				
Beam Pointing *	41.0°N, 79.5°W (North Beam)	Rocky Mt. East Mode: 44.9°N, 107.6°W (North Beam) Rocky Mt. West Mode: 43.4°N, 115.2°W (North Beam)	48.5°N, 121.7°W (Z-axis)	60.7°N, 139.2°W (North Beam)
Uplink:			Any Comprehensive Terminal	
Program Origination (freq)	Denver (6 GHz)		Seattle/Omak ² (6 GHz)	in AK (2250 MHz) ²
Downlink: freqs	<div style="text-align: center;"> ← 4 GHz → </div>			
Earth Coverage Horn				
North Beam (4)	2569	2670		2569
South Beam (4)	2670	2569		
Alaska				
Seattle/Omak			4GHz	
Voice and Data Links				
Up: 149 MHz		ATS-3		ATS-1
Down: 135 MHz		half duplex		simplex

*Two footprints (north and south) are provided to each experimenter: pointing is referenced to the footprint listed in parentheses.

1 Earth Coverage horn
2 PFF on 30' dish

Table 1

NASA HQ EC75-15948 (1) 3-24-75

ALASKA EXPERIMENTAL SATELLITE COMMUNICATIONS PROJECT

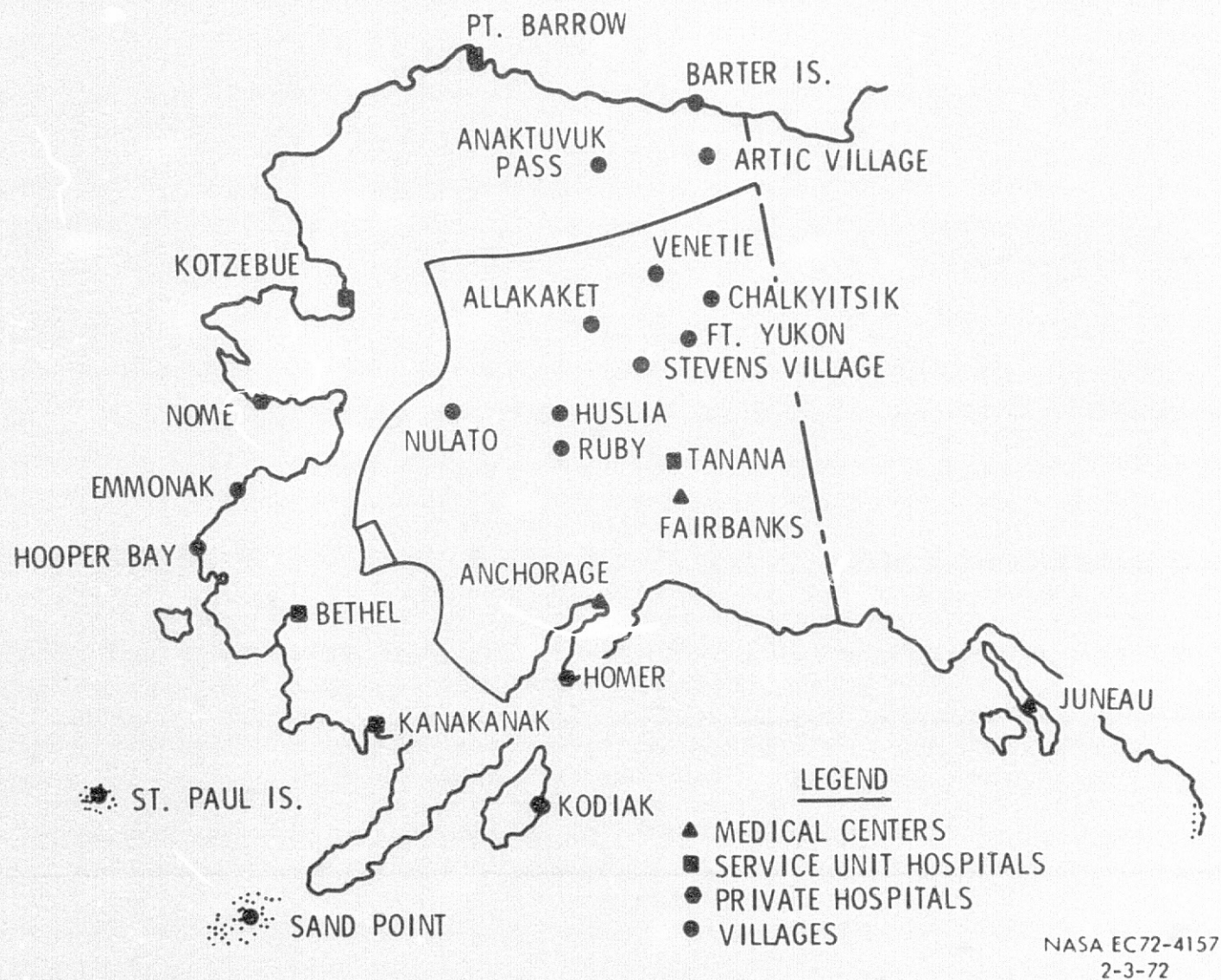


Figure 1

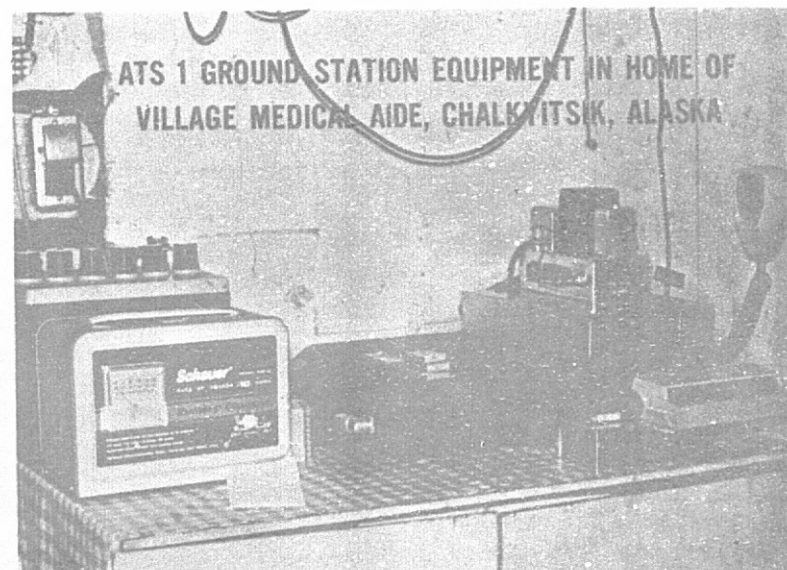
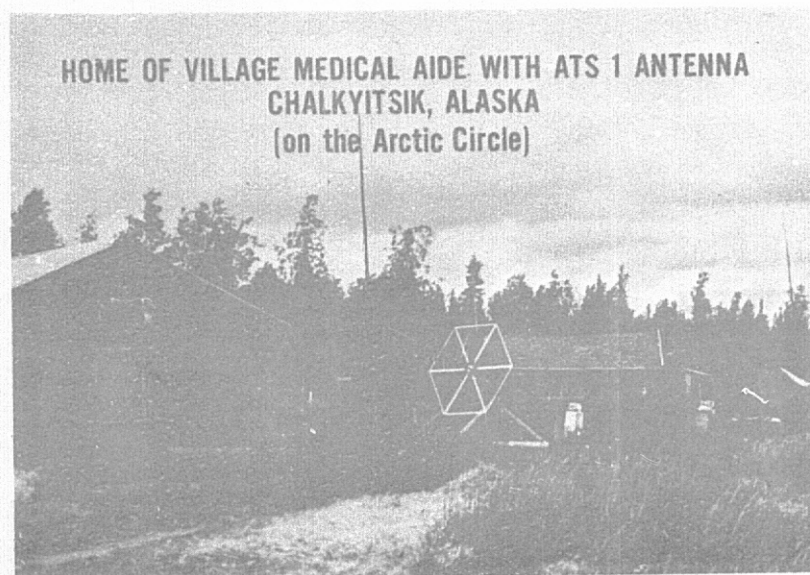
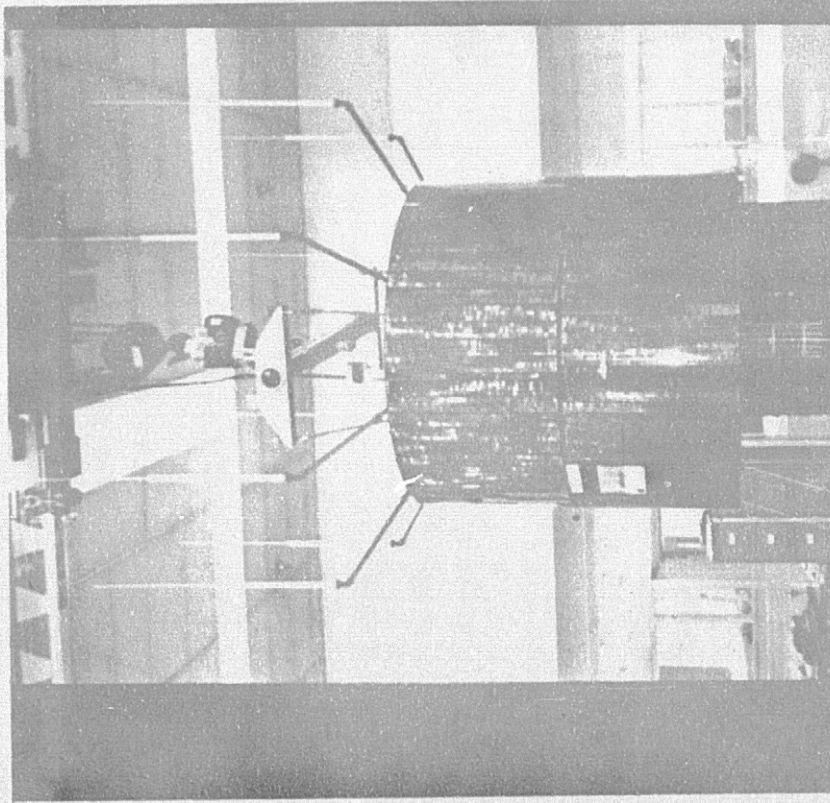


Figure 2

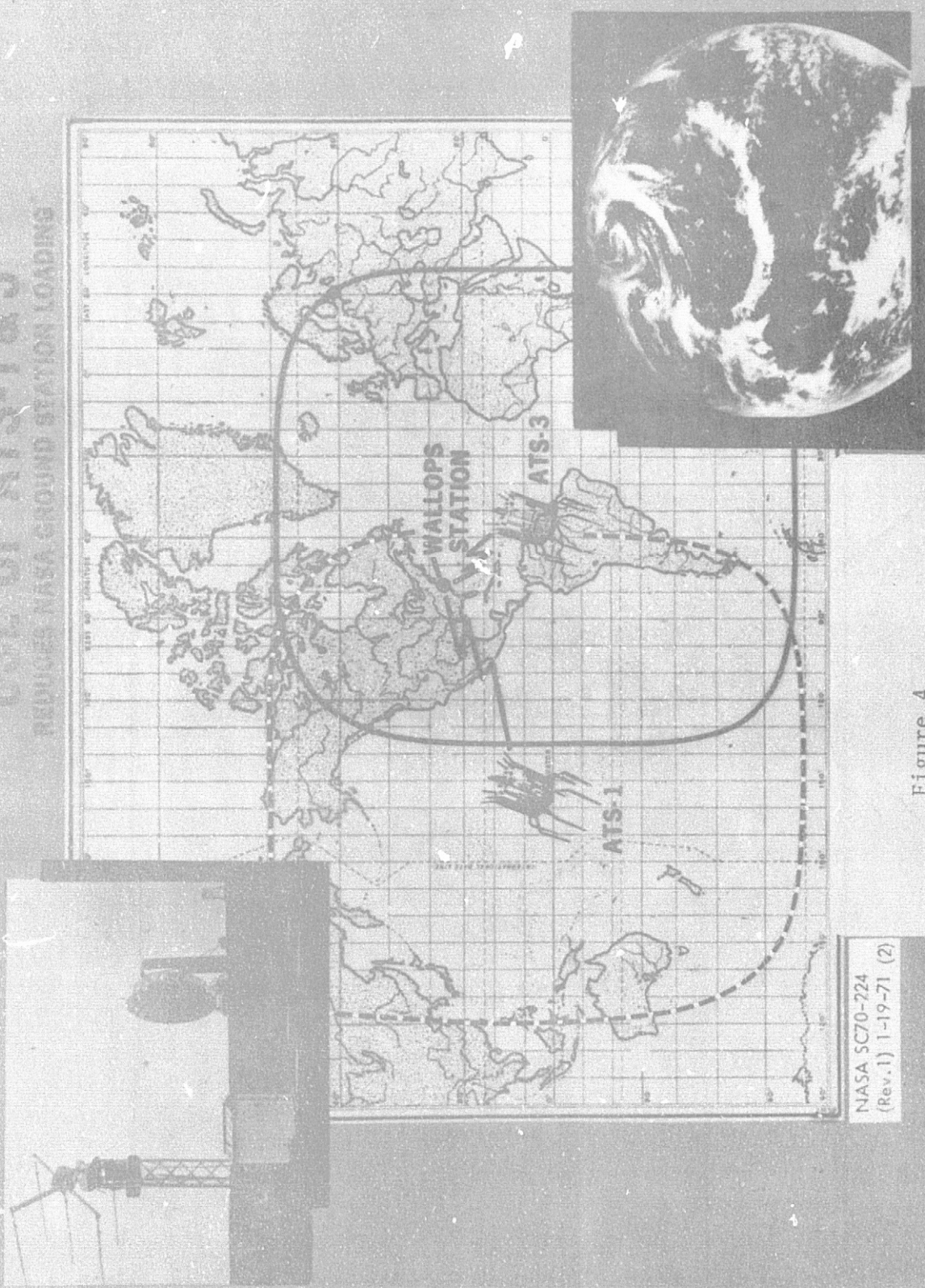


ATS-1
LAUNCHED DEC. 5, 1966
STATION 150° WEST
CONDITION OPERATING:
6 OF 10 EXPERIMENTS

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Figure 3

COMMUNICATIONS PROGRAMS
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
USE OF ATS-1 & 3
REDUCES NASA GROUND STATION LOADING



NASA SC70-224
(Rev. 1) 1-19-71 (2)

Figure 4

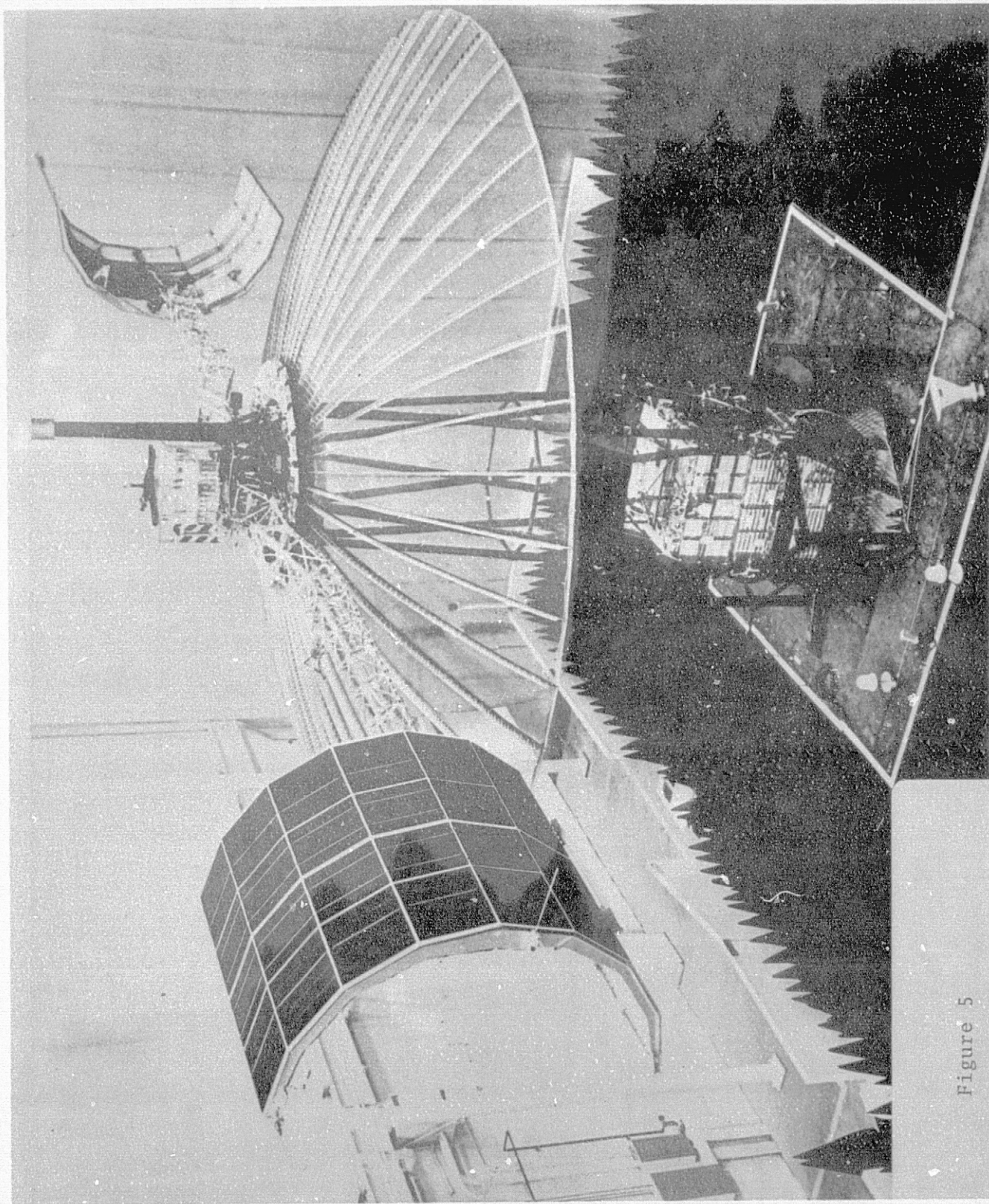
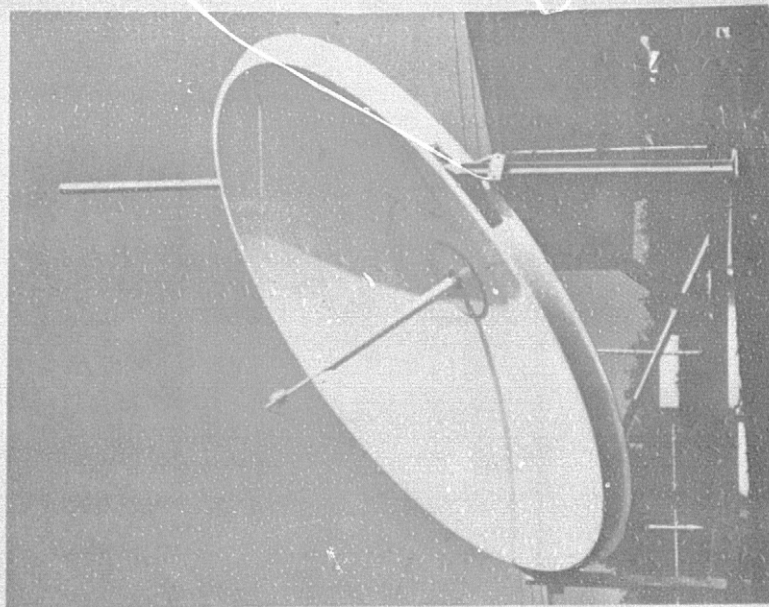


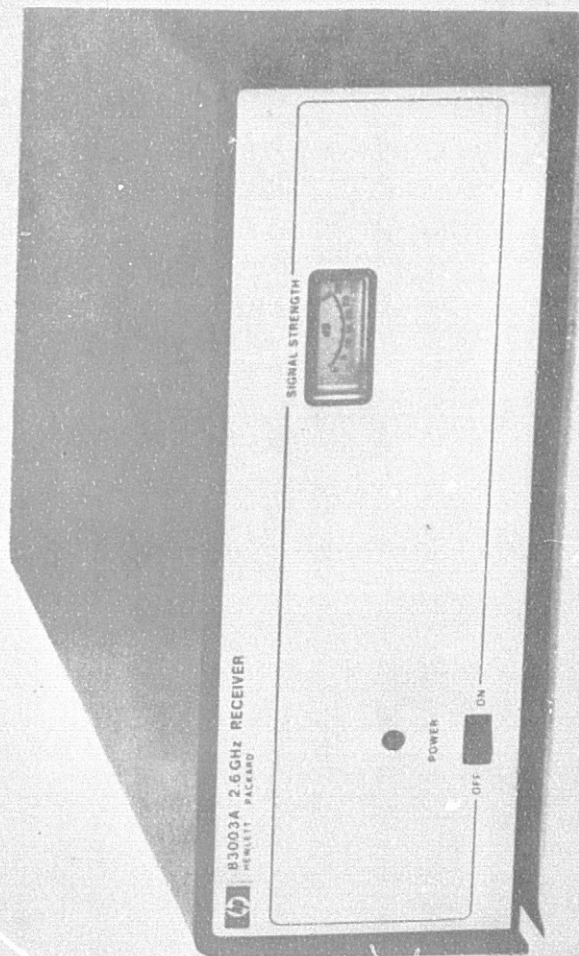
Figure 5

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RECEIVE-ONLY TERMINAL



(A) ANTENNA ASSEMBLY

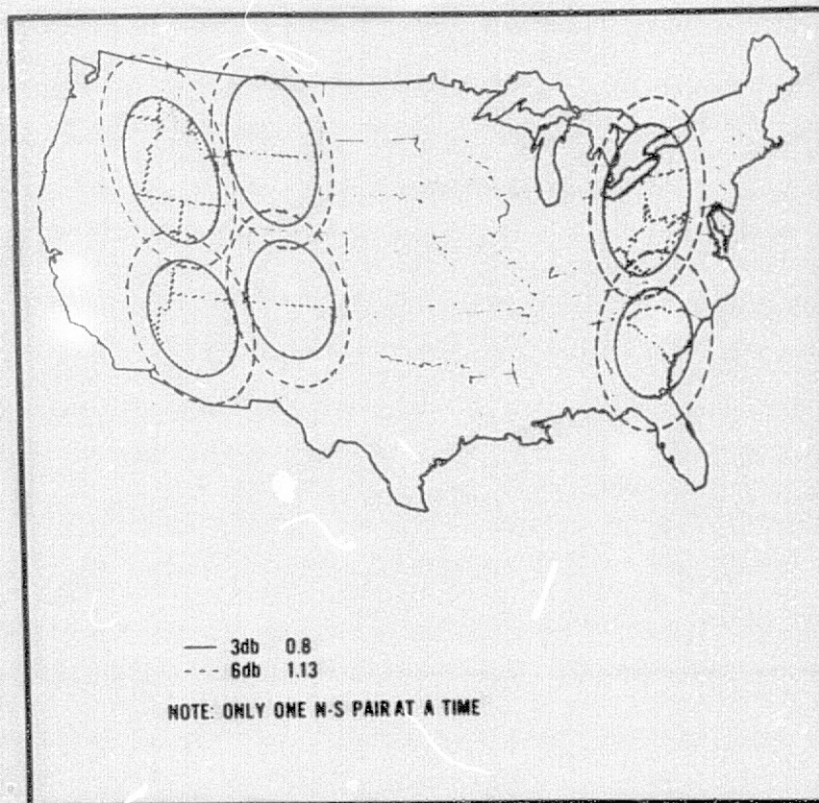
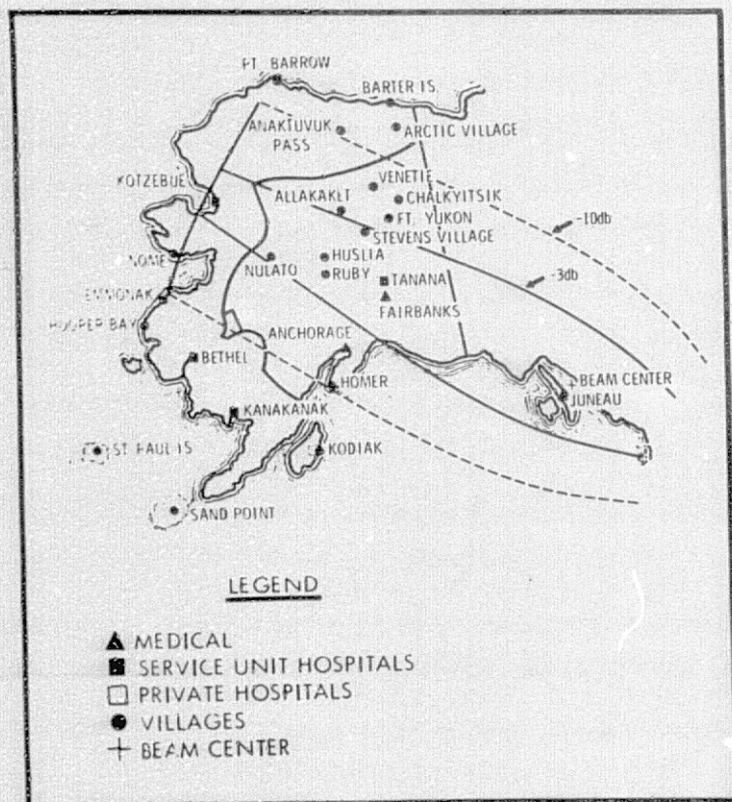


(B) INDOOR UNIT

NASA HQ 2C75-15947 (2)
3-74-75

Figure 6

ATS-F HET FOOTPRINTS IN ALASKA, ROCKY MOUNTAIN AND APPALACHIAN REGIONS (SATELLITE AT 94° WEST LONGITUDE)



NASA EC74-1114
2-12-74

Figure 7

OVERVIEW OF HET NETWORK

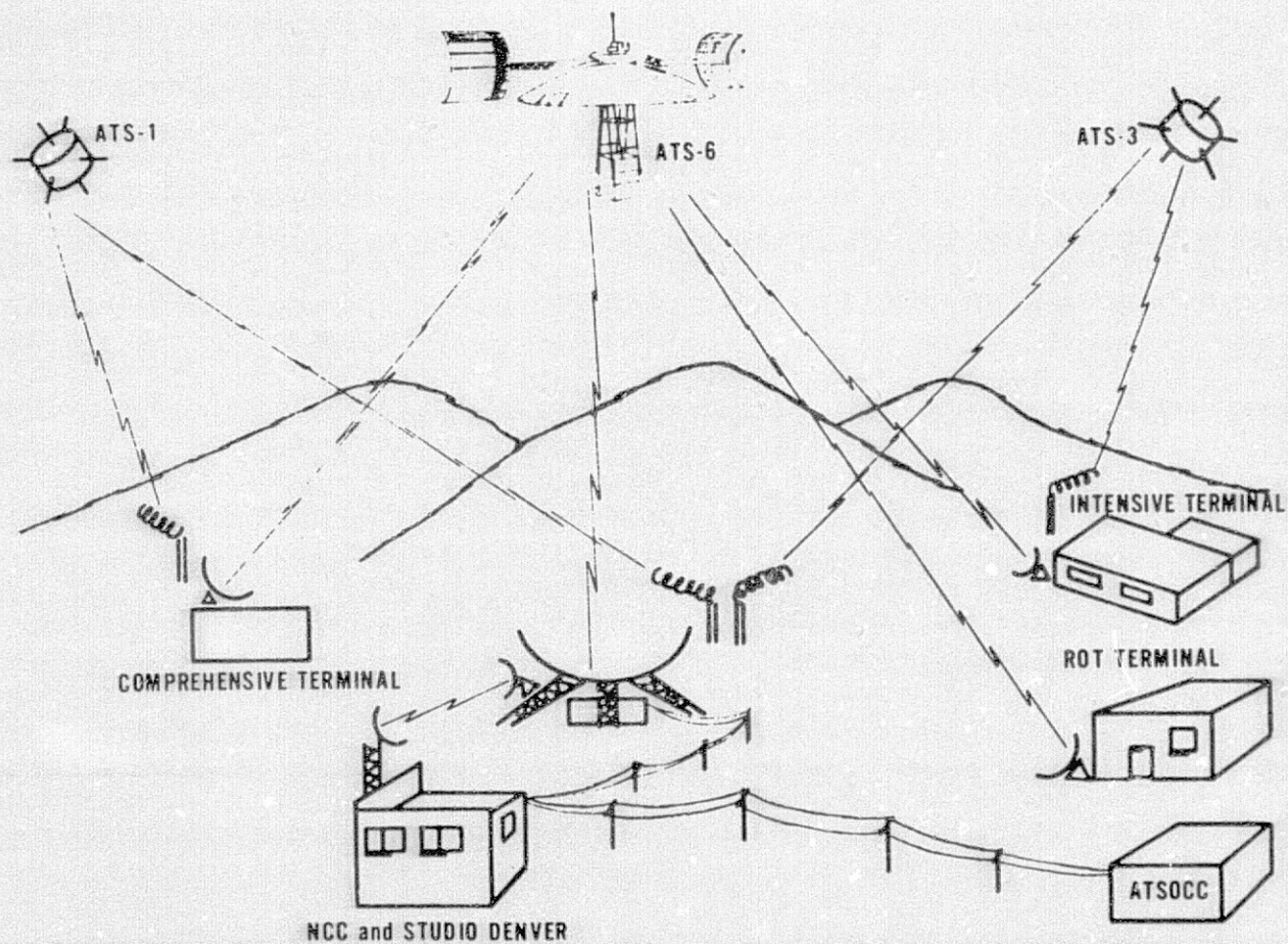
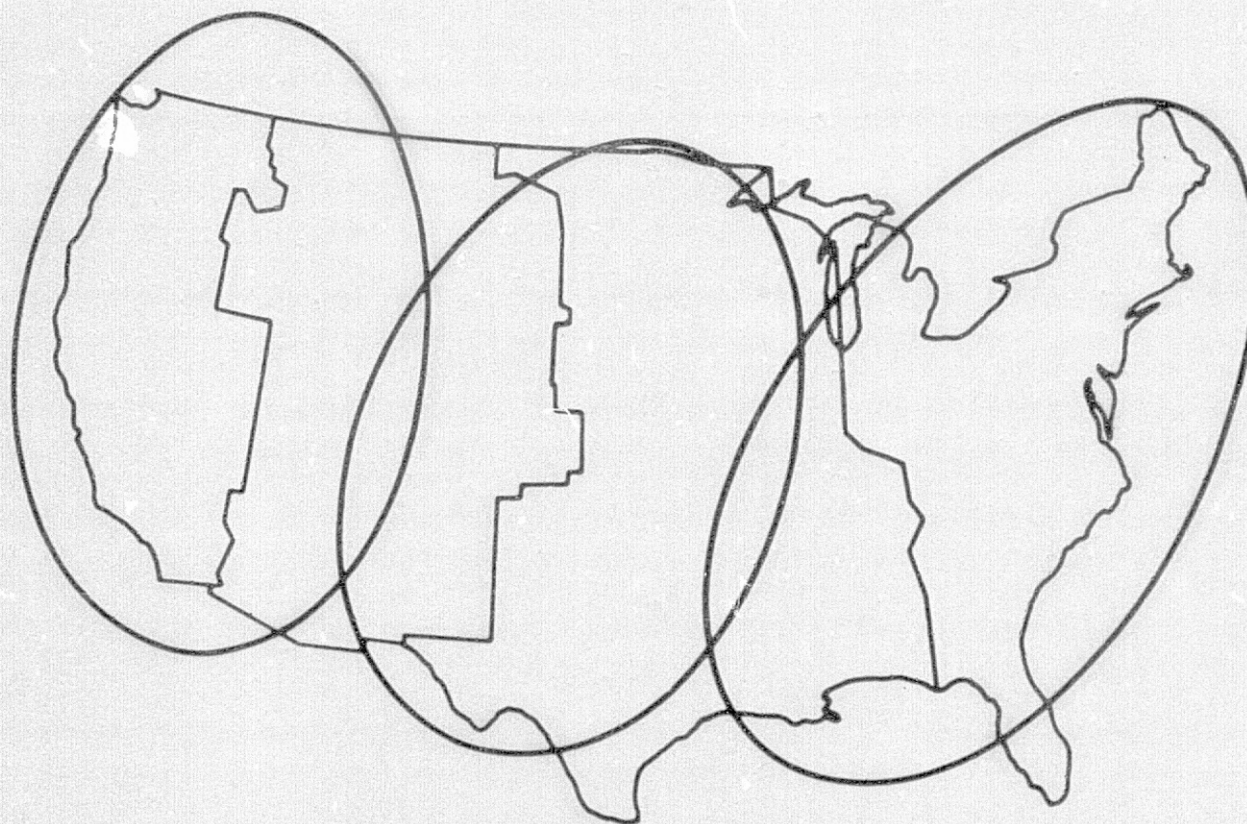


Figure 8

CTS ANTENNA BEAM FOOTPRINTS OVER CONTINENTAL U.S.



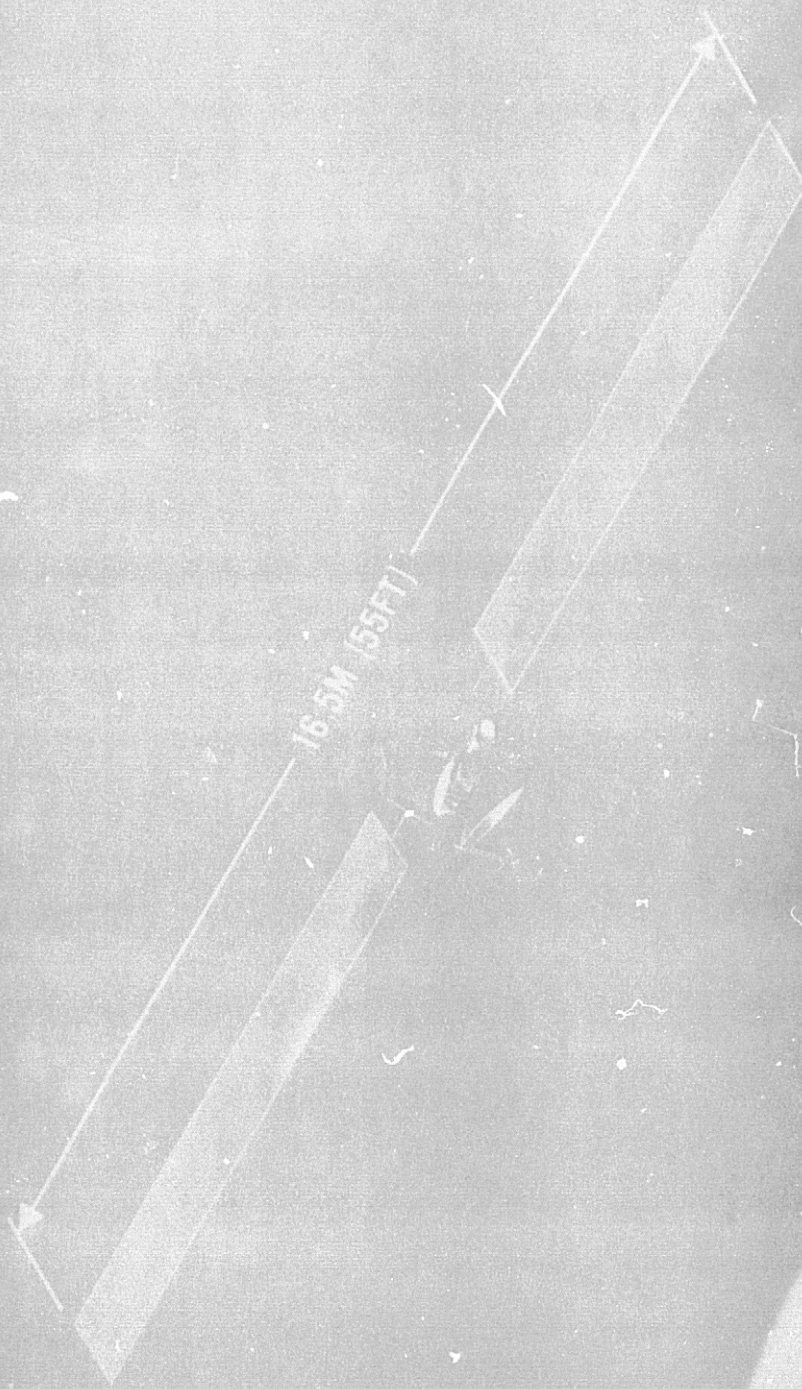
SATELLITE LONGITUDE = 114° W
HALF POWER BEAMWIDTH = 2.50°

NOTE: ONLY 2 ZONES CAN BE COVERED SIMULTANEOUSLY

NASA EC72-4179
(Rev. 2) 12-29-72

Figure 9

COMMUNICATIONS TECHNOLOGY SATELLITE (CTS)



NASA EC72-4154 (3)
2-5-72

Figure 10

HEALTH EDUCATION TELECOMMUNICATIONS EXPERIMENT VETERANS ADMINISTRATION'S
EXCHANGE OF MEDICAL INFORMATION PROGRAM APPLICATIONS TECHNOLOGY SATELLITE - F

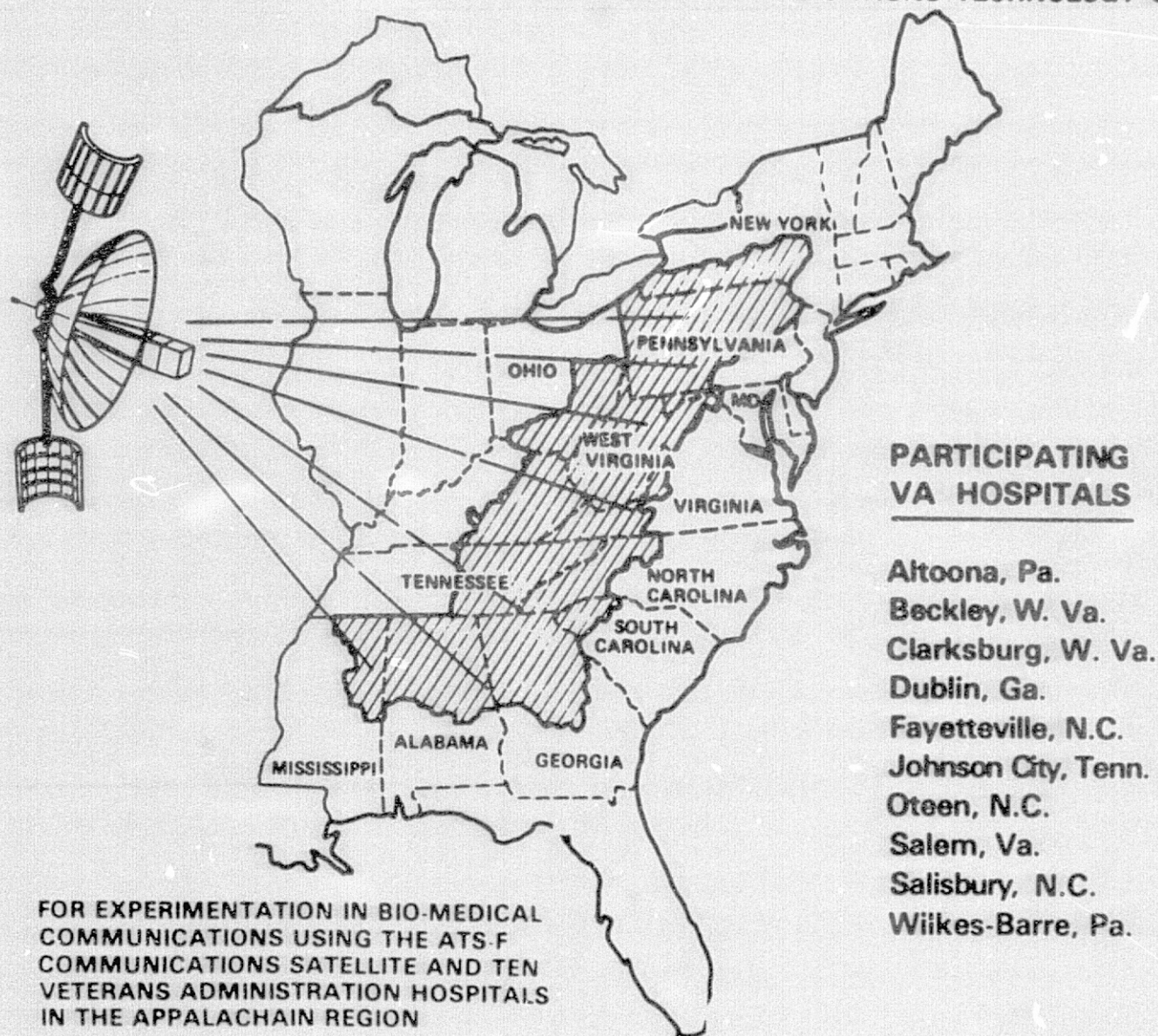


Figure 11

**ATS-6 HET EXPERIMENT
UNIVERSITY OF WASHINGTON REGIONALIZED
MEDICAL SCHOOL LECTURE FROM SEATTLE
TO MEDICAL STUDENTS IN FAIRBANKS**

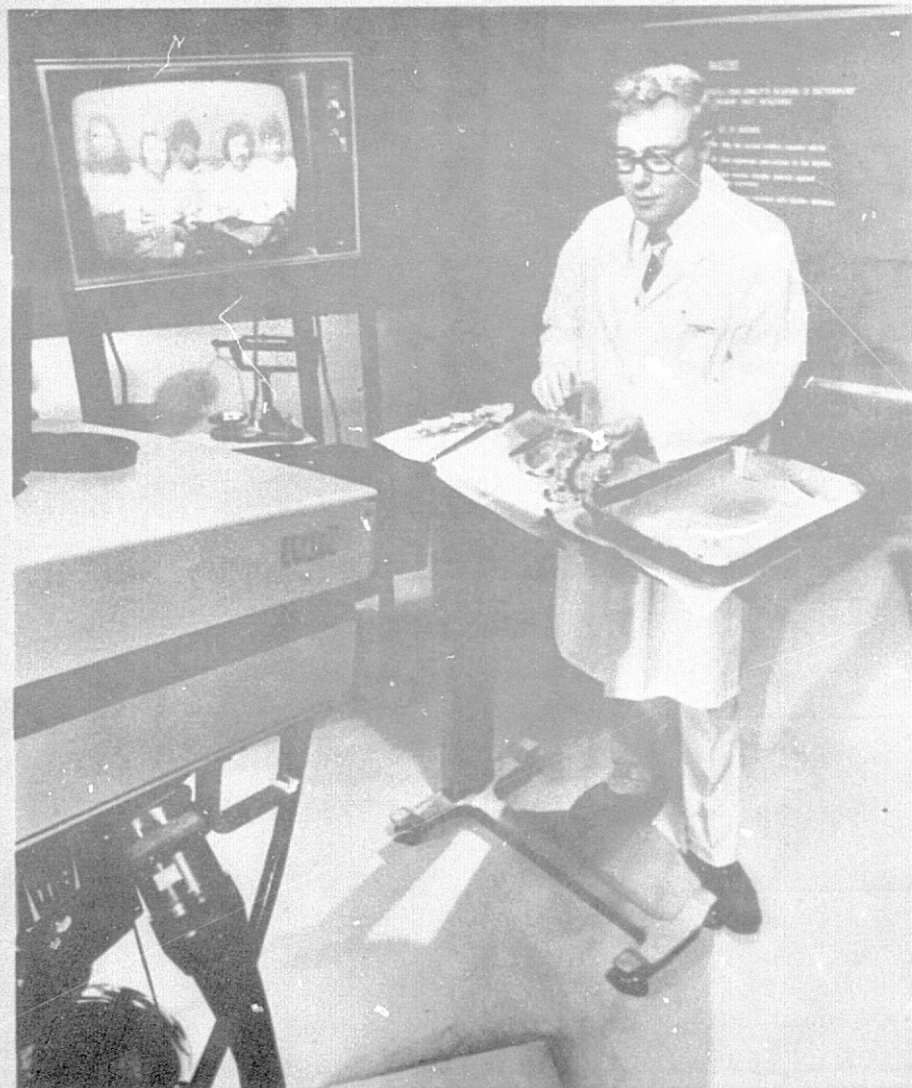


Figure 12

NASA HQ EC75-15396(2)
1-10-75

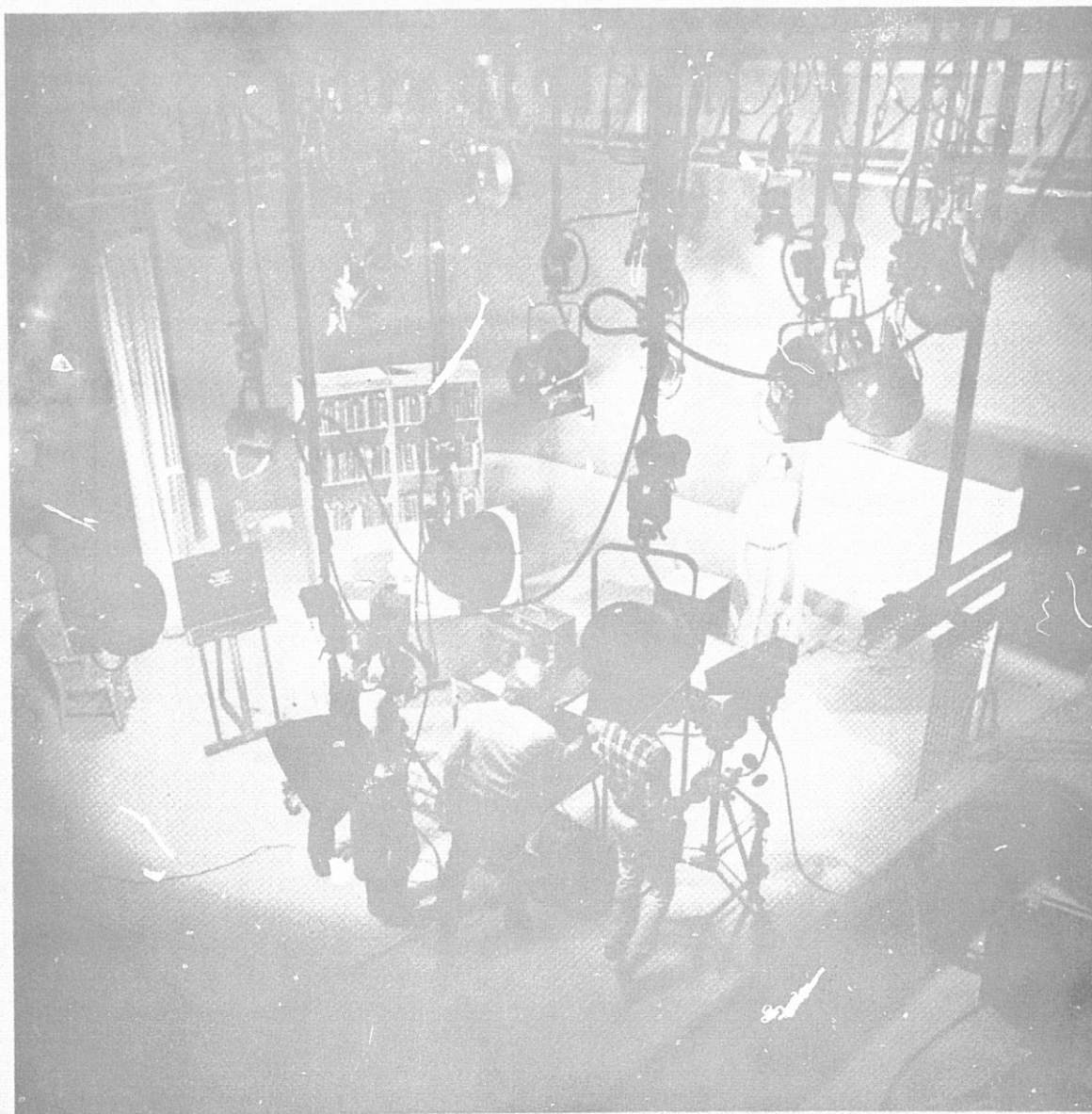
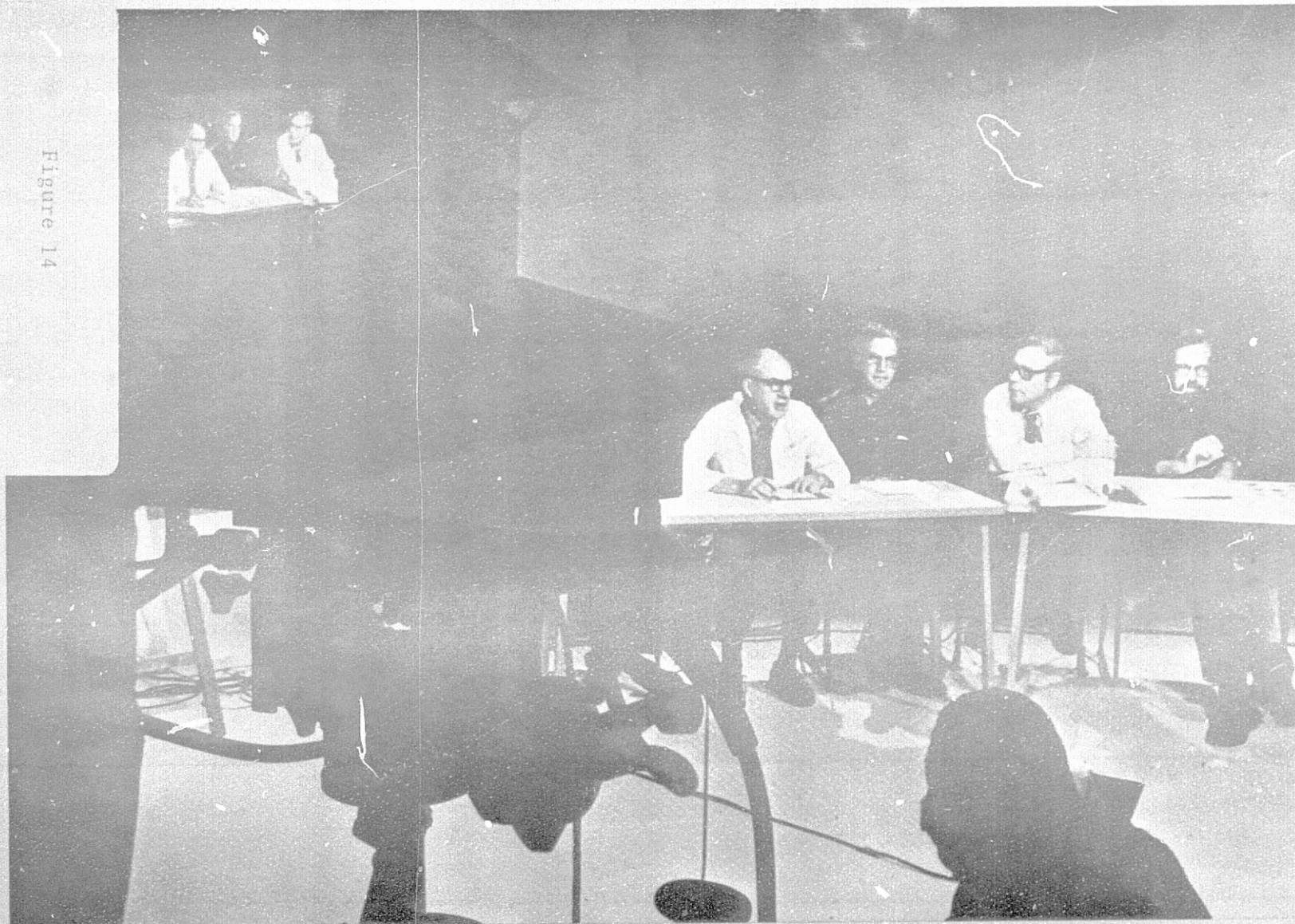


Figure 36. Equipment set up for a lecture/discussion in the Closed Circuit Television studio of the University of Washington Health Sciences Center.

Figure 15

Figure 14



In Seattle, University of Washington faculty members discuss, via a satellite broadcast, curriculum plans with University of Alaska faculty members. The UW professors are, from the left, Dr. Earl Benditt, Chairman, Pathology; Dr. Edward Smuckler, Professor, Pathology; Dr. Gary Striker, Assistant Dean, Curriculum, and Dr. Albert Gordon, Associate Professor, Physiology and Biophysics.

STARPAHC
A Progress Report

Norman Belasco*

INTRODUCTION

The delivery of quality health care to the crew and passengers of extended-mission spacecraft has many similar aspects to the delivery of quality health care to populations located in remote geographic areas on earth. In both cases the need exists to extend the capability, knowledge, and skill of the physician to a point many miles distant from his physical location. The means that will permit physicians to direct quality health care delivery, without being physically present, may provide a satisfactory solution.

One such approach is the utilization of space technology in communications and data systems, coupled with the use of trained allied health professionals (such as physician's assistants). This is the basis for the STARPAHC system, which has been designed, assembled and installed at a test site where it will be operated and evaluated for approximately 2 years. During the operational period, data being gathered will be valuable to two goals, (1) the development of health care systems for future manned spacecraft, through

- Further development of the physician-paramedic link
- Clinical evaluation of advanced bioinstrumentation
- Development of computer support for remote health care
- Integration of video viewing and display devices
- Definition of skills, training and procedural requirements
- Evaluation of existing techniques for space application
- Identification of technology advancement need areas
- Refinement of protocols and techniques

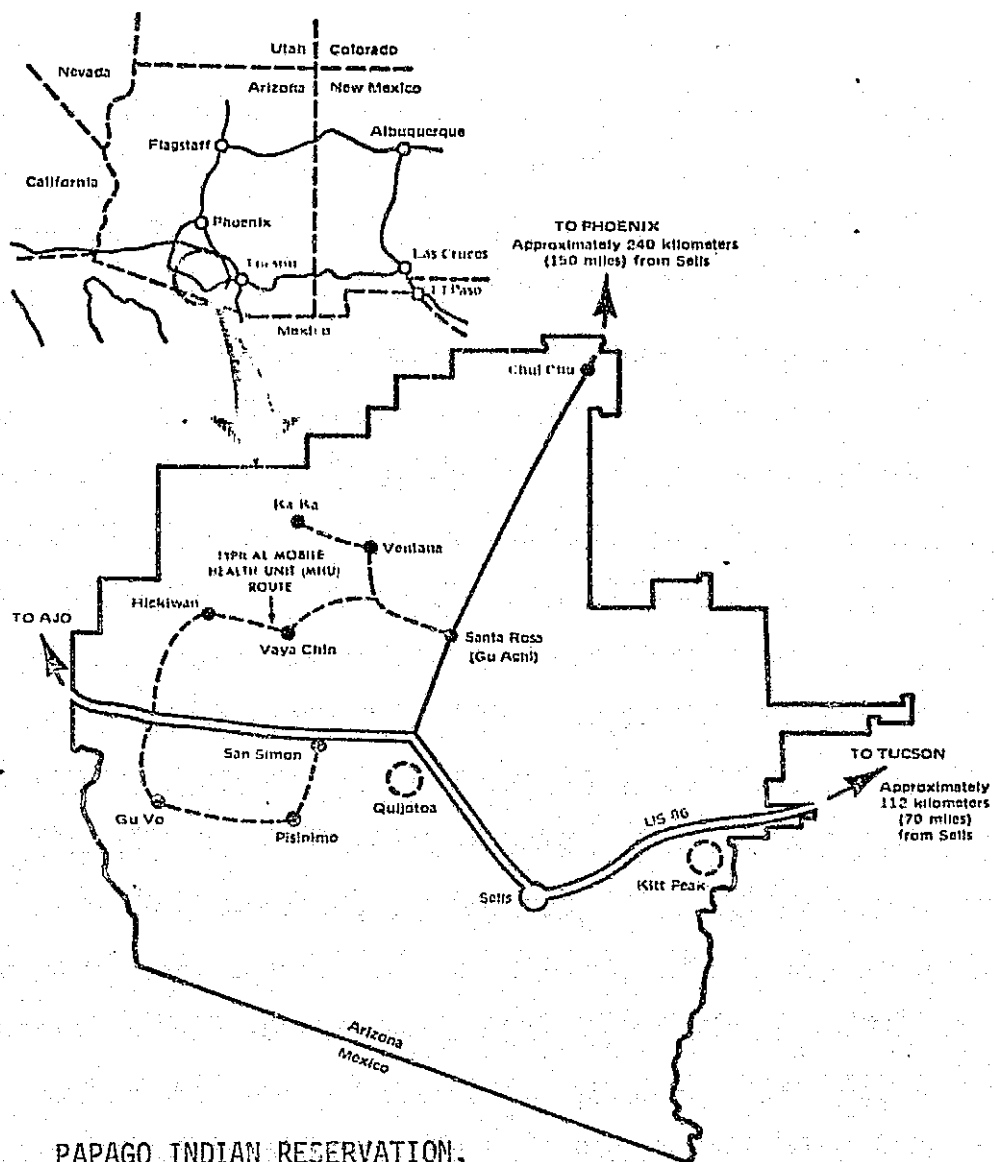
and, (2) determining the effectiveness and exportability of the system, its elements and protocols for improving delivery of health care to populations of remote areas on earth, through

- Improved communication methods
- Mobile health clinic staffed by physician's assistants

* IMBLS Project Officer, L. B. Johnson Space Center, Houston, Texas

- Advanced health care equipment
- Computer aids
- Assistance to allied health professionals and health education programs

This NASA Lyndon B. Johnson Space Center program is being conducted in conjunction with the Indian Health Service (IHS) and with the cooperation of the Papago Tribe Executive Health Staff. Lockheed Missiles and Space Company, Inc., is the NASA systems contractor.



PAPAGO INDIAN RESERVATION,
ARIZONA

The Site: The Papago Indian Reservation, Arizona

On April 17, 1973, HEW Secretary Caspar Weinberger announced that the Papago Indian Reservation would be the site for operational testing of a system "to improve medical care in space and remote earth locations." Accordingly, the program now is identified with the name STARPAHC, which is the acronym for Space Technology Applied to Rural Papago Advanced Health Care.

The Papago site was selected by HEW and NASA based on many reasons, including the community's willingness to support the cost of the system after the test period is completed, and its willingness to accept primary care from physician's assistants. Beneficiaries will be the 8-10 thousand permanent residents of 75 villages in the Papago reservation, and also the 2-4 thousand who live outside the reservation's boundaries but return to the reservation for health care. The tribe governs itself through a tribal council and has complete police jurisdiction on the reservation. Average family size is 4.8 persons with a median age of 21 years.

The Papago reservation covers approximately 11,180 square kilometers (4,300 square miles) west of Tucson and south of Phoenix (left) with the Mexican border on its south boundary. The reservation is in the Sonora Desert - a rough, dry terrain with intermittent mountain clusters. Utilities, where available, are fair to poor in quality. Power outages of 6 hours or more are a frequent occurrence in July and August, even at Sells and Santa Rosa, the "big cities." Villages have wells which provide water needed for subsistence. Highways are asphalt surfaced while other roads are graveled, unpaved and bumpy, which can be hazardous immediately after rainstorms. The main industry is raising cattle, with little farming, and the average annual income is approximately \$900 per family.

HEW's Indian Health Service (IHS) administers health care on the reservation through a hospital at Sells and a part-time clinic at Santa Rosa. A large, well-equipped Indian Health Hospital is in Phoenix with many specialists on the staff. In the STARPAHC system, Sells and Santa Rosa have been selected as key elements for the Support Control Center (SCC) and the Local Health Services Center (LHSC), respectively. Also, the Phoenix hospital is the Primary Referral Center (PRC). For health care service to remotely located villages, this program will use a Mobile Health Unit (MHU), a well-equipped vehicle clinic facility staffed by physician's assistants.

System Configuration

The STARPAHC system synthesizes a series of basic facilities, service elements and supporting functions into an operating system consisting primarily of:

1. The Health Services Support Control Center (HSSCC or SCC) is

located in one wing of the Sells Hospital and is analogous to the Mission Control Center at the L. B. Johnson Space Center. It is staffed by physicians and a system operator.

2. A Local Health Service Center (LHSC) is the Santa Rosa Clinic. It is staffed by a physician's assistant and functions as a fixed remote clinic.

3. The Mobile Health Unit (MHU), a clinically equipped van-type vehicle staffed with a physician's assistant and a laboratory technician, functions as a remote mobile clinic, visiting villages on a preselected route and schedule.

4. The Phoenix Referral Center (PRC) is a dedicated room in the Indian Health Hospital in Phoenix for access to specialists, through audio and slow-scan television links with the SCC, LHSC and MHU.

5. The Tucson Computer Center (TCC) provides STARPAHC data system access to the Indian Health Service HIS (Health Information System) data base.

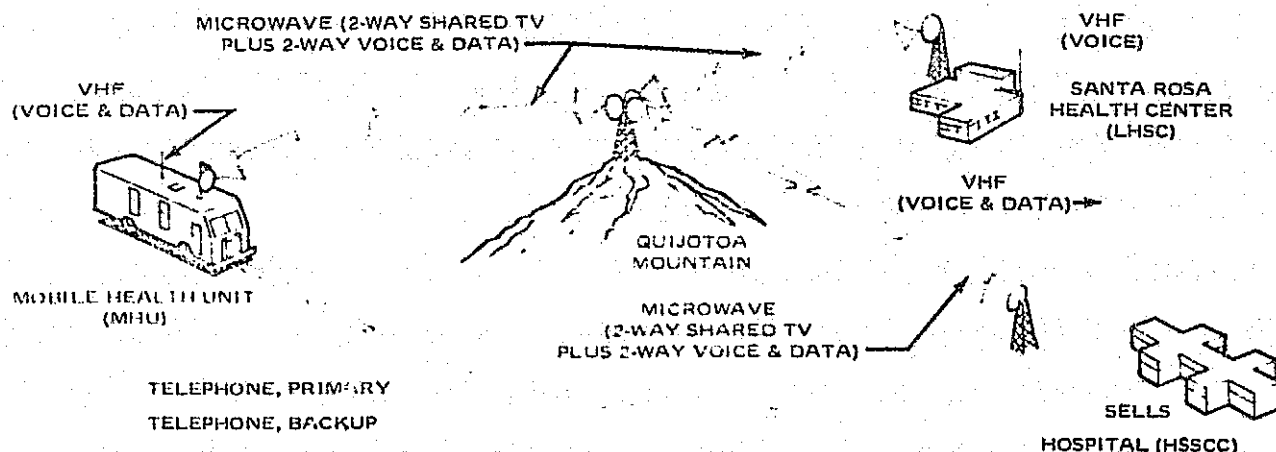
6. The Quijotoa Relay Station (QRS) is used for microwave and VHF transmission of television, voice and data between major system elements.

7. The Telecare unit, a suitcase-size portable, ambulance-carried selection of medical equipment for emergencies and house calls to bed-ridden patients.

System Operation

The basic operational features of the STARPAHC system are:

1. Medically-trained Community Health Medics (CHMs), also known



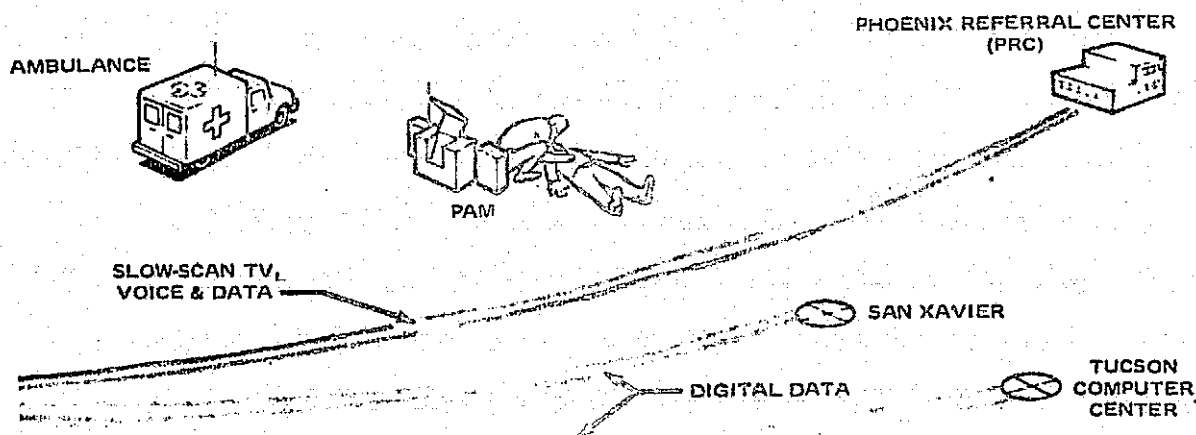
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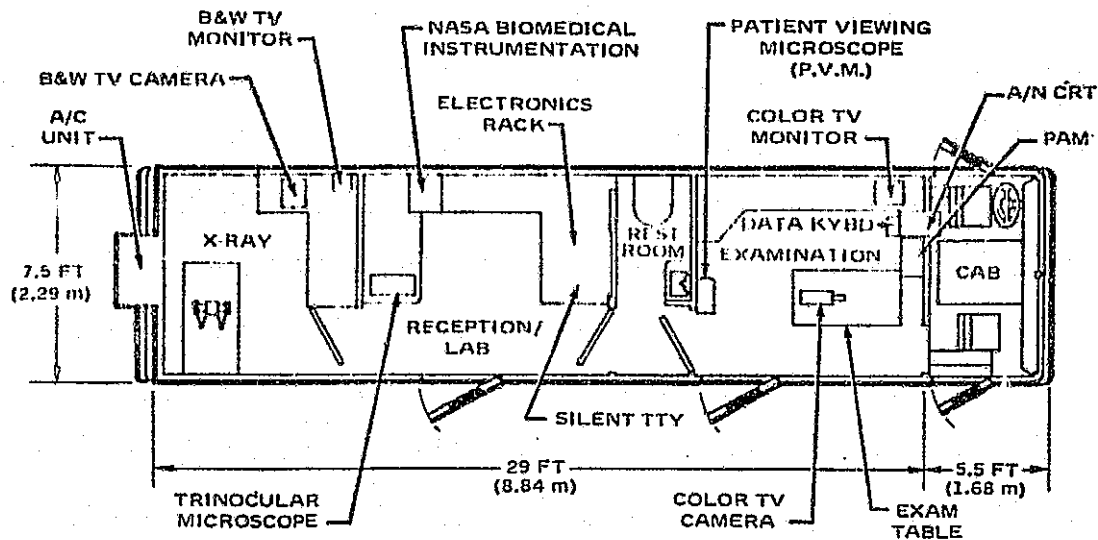
as physician's assistants, are at the fixed clinic (LHSC) and mobile clinic (MHU). These CHMs administer health care to patients under the direct supervision of the physicians who are miles away at the Sells Hospital (SCC). The CHMs are linked to the physician by radio and TV hookups, enabling the physician to view the patient or his affected body area, x-rays, microscopic slides, etc. Simultaneously, descriptions and responses to the physician's questions (by the CHM and the patient) can take place via the radio link. This in effect extends the high-quality diagnostic and treatment capability of the physician over large distances and multiple clinics while he is located at the central hospital.

2. An automatic data processing network supports the activities of the physician, CHM, laboratory technician and other system personnel by enabling them to request important information from the computer using typewriter keyboard-type terminals. The requested information is displayed on a TV-type screen almost instantaneously and can include the patient's history, instruction for care, diagnostic aids, etc. Following the patient's visit, information is entered into the data system via the same terminals so that all patient information will be current.

3. In cases where the physician at the SCC wants to consult with a specialist in the Phoenix Indian Health Hospital, he has the capability for transmitting views of x-rays, wounds, lesions, patients, etc., plus a direct telephone line for discussion with the specialist. Similar transmitting capabilities exist for the MHU and the LHSC utilizing the equipment at the SCC.

4. This combination of capabilities enables patients at the remote clinics to be diagnosed by the physician miles away at the hospital, and to be immediately treated by the CHM in the clinic under the physician's direction. The entire activity is accomplished in minimum time and without the patient traveling considerable distances.





Floor Plan of MHU

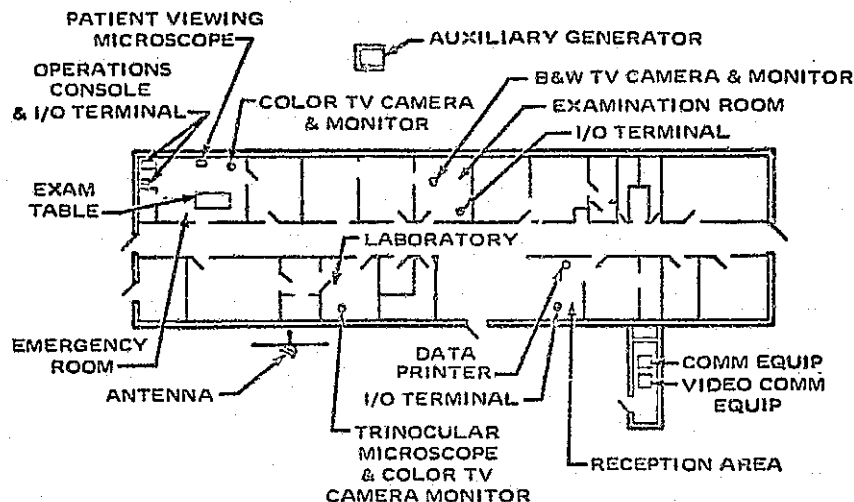
The Mobile Health Unit (MHU)

The MHU (above) is a mobile clinic visiting villages on a scheduled basis. Staffed by CHMs and laboratory technicians, the MHU gives the physician a flexible "outreach" capability (see map for MHU route on p. 2).

A patient enters the reception area and is interviewed by a CHM as to complaint, duration of symptoms, etc. The CHM determines the need to call up a patient history or other information using the data terminal keyboard. Patient examination takes place in the examining room where the physician is in radio contact with the CHM and can view the patient via color TV (CHM uses the TV camera above the examining table). If the physician decides that a view of a body orifice such as the throat is necessary, then the CHM uses the patient-viewing microscope under voice direction of the physician, checking with the TV monitor. The patient-viewing microscope uses fiber optics to illuminate the viewing area and to return the image to a TV camera, televising it to the physician at the SCC. Should the physician require slide viewing, such as a blood smear or culture, the trinocular microscope assembly includes a TV camera to transmit the view through the microscope to the physician. The laboratory area also contains many capabilities for biochemical analyses usually required for clinical examinations (blood work, urinalysis, etc.). When x-rays are required, the procedures of taking and developing the x-rays are accomplished in the x-ray room. This room also contains equipment enabling the technician to transmit the x-ray to the physician at the SCC via TV.

Santa Rosa Clinic - Local Health Services Center (LHSC)

The LHSC (right) is an existing Indian Health Service clinic whose



Floor Plan of LHSC

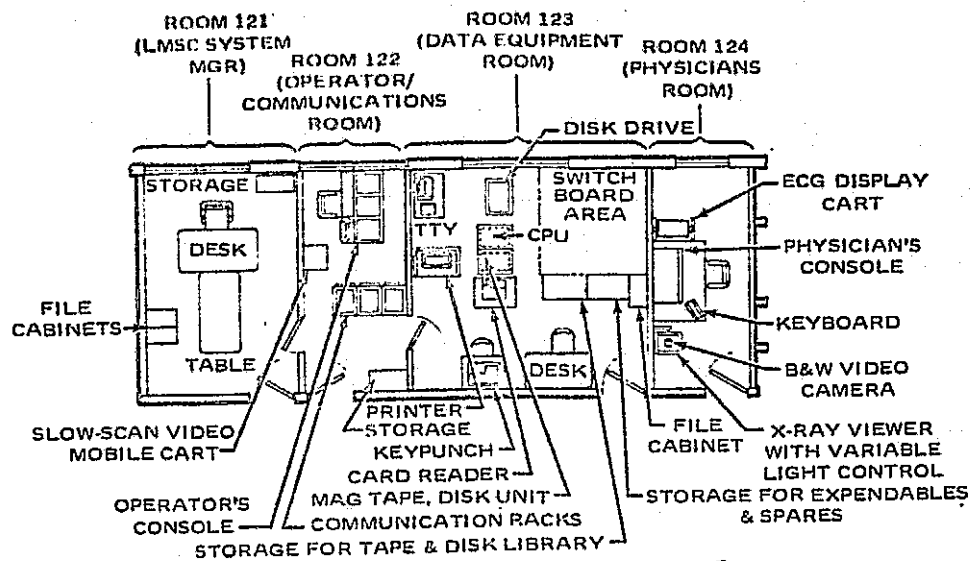
capabilities are enhanced by the equipment and personnel needed to meet its functions in the STARPAHC system. The LHSC is a well-equipped clinic, staffed with CHMs, laboratory technicians, and a secretary/receptionist. Like the MHU, its function provides the physician at the SCC with "out-reach" capability to deliver quality health care to patients through STARPAHC. It has considerably more usable area and more clinical examination, patient treatment, and laboratory capabilities than the MHU. Its operational procedures for patient, CHM, or physician activity are generally identical to those described for the MHU.

Sells Hospital - Health Services Support Control Center (SCC)

The SCC is the base for the STARPAHC operations. The Indian Health Service hospital at Sells, Arizona contains a portion of one wing as the STARPAHC system control center (next page). Here the physician directs the CHMs and laboratory technicians, communicates with patients, and calls up data to assist in the patient examination and treatment. He also consults with specialists at the PRC and directs the system operator for specific functions such as recording TV images, sending slo-scan x-rays to the PRC, or patching in other needed capabilities.

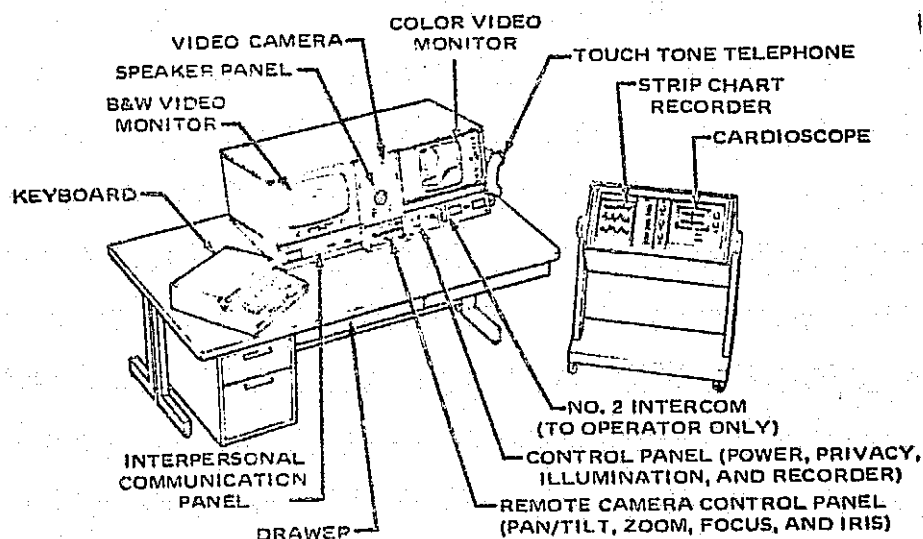
As the operational base, the SCC contains the system data processing equipment and maintenance workshops (not shown). Supporting engineering functions such as scheduling, logistics, maintenance, reporting, etc., are managed and controlled from the SCC.

The physician's console (next page) in the SCC is the focal point of the system. As the system's control center, it provides physicians with the displays and controls required to perform their comprehensive functions. The controls and displays have been carefully selected to give



SCC Floor Plan

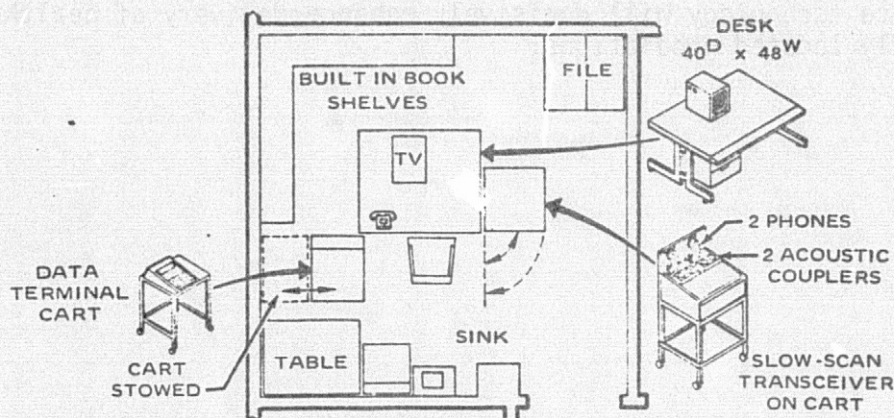
physicians command flexibility and a maximum amount of information without diluting their activity with detailed technical functions. An option for the physician to control privacy on the voice and TV circuits is another system feature. Most important to his visual examination of the patient is the capability to remotely control the TV cameras at the MHU and LHSC directly from his console.



Physician's Console

Phoenix Referral Center (PRC)

The Indian Health Hospital at Phoenix, Arizona is staffed with and has access to medical specialists. In the STARPAHC system these specialists will be called upon to consult with the physicians at the SCC when unique or complex medical advice is in order. To enhance the consultation, the system provides the capability for transmitting x-rays or pictures of the patient, lesions, etc., via slo-scan black-and-white TV using existing telephone lines. These same telephone lines also provide voice communication and data transmission between the SCC and the PRC. The slo-scan affords x-ray or picture transmission in 45 to 90 seconds. It inherently records the transmission and provides almost unlimited playback for extensive, repetitive studying at different times and for varying durations.



Floor Plan of PRC Diagnostic Center

PROGRESS AND STATUS

Subsequent to system installation, checkout of the major subsystems and total system proceeded. It was during this period that the normal frustrations associated with equipment failures and replacements were experienced--but with decreasing frequency as "on-line burn-in" continued. Also during this period, personnel were trained for daily routine field operations of STARPAHC. When the installation, checkout and training were judged to be completed, the program progressed to acceptance testing. This is a series of tests to determine the readiness of hardware, software and personnel to do the jobs for which they were intended. In the case of STARPAHC, the acceptance tests consisted of two major sections.

The first section of tests was directed at equipment and software elements, subsystems and the total system to determine the compliance to engineering and performance specifications. The second group of tests

was structured to determine the acceptability of the proficiency levels attained by the operating team using the STARPAHC hardware and software. Hypothetical representative scenarios, prepared by the Indian Health Service, were used to simulate anticipated patient encounters and, thus, enable realistic assessment of team performance and the man-machine interfaces. Both sections of the acceptance testing were concluded acceptably.

During the testing period, local community orientation proceeded in earnest. The Papago people had to become familiar with and accept this new approach to health care delivery if the program were to provide its potential benefits. Members of the IHS and Papago Executive Health Staff labored hard and long to assure local community acceptance of STARPAHC.

At present the system has started its routine operations, under the direction of the Indian Health Service, improving the delivery of health care to the Papago people. It is anticipated that much will be learned from this pilot project, and that this unique comprehensive utilization of space technology will decisively enhance delivery of health care to remotely located populations.

TRANSPORTATION

Session Chairman: Dawson A. Mills, M.D.

Private Emergency Medical Transportation Systems

Richard E. Zuschlag

Military Assistance to Safety and Traffic

Captain Herbert A. Coley

Emergency Medical Services in a Rural Environment

Richard H. Clark, Jr., M.D.

**Technology Utilization Programs at the
NASA Lyndon B. Johnson Space Center**

John L. Sigmon

Private Emergency Medical Transportation Systems

Richard E. Zuschlag

I would like to thank Dr. Portnoy and his staff for inviting me to share with you some of my ideas on private emergency medical transportation. There are undoubtedly areas in this country where public emergency medical transportation systems can serve more effectively than private systems but both public and private agencies are necessary for the overall improvement of emergency medical services. Sometimes, when you are up to your rear end in alligators, you forget that the primary objective was to drain the swamp.

Acadian Ambulance Service conducts an annual membership campaign, which is its financial backbone, supplying two-thirds of the required income for operating in Southwest Louisiana. We will talk a little bit about this unique membership concept but first, you need some background about Acadian Ambulance Service, Inc. Three young men - I was one of them - founded the organization in 1971. My background is communications; one partner, a former hospital administrator, trained in Business Administration and the third is in the accounting field. We visited a number of ambulance services throughout the United States and a composite of their ideas and ours formed the basic AASI structure.

We started with two ambulances and a staff of eight men. Our best resource has been Chief Martin and the Houston Fire Department personnel, who, through cooperation and support, have helped us tremendously. The membership method of funding was modeled on a plan similar to one in my home town in Pennsylvania. We use a man-hour schedule originated by Max Constantin who has been operating a private ambulance service, employing military medics, in Baton Rouge for the last 18 years.

As you can see from the map, Acadian Ambulance Service is operating in 11 Louisiana parishes covering just over 8,600 square miles and serving more than one half million people. We believe AASI is unique in that we have been blessed with tremendous cooperation from police juries, a local governing body comparable to county commissioners in other states. These police juries have supported our endeavors, both morally and politically. You see, the parishes had no funding system for emergency medical services and the people would not vote in

Secretary-Treasurer
Acadian Ambulance Service, Inc.

any additional taxes. In fact, in one parish, a specific bond election was voted down two to one. However, when we conducted our annual campaign in that area, more people bought annual memberships than voted in the entire election. The public evidently chose to endorse our service over supporting a public service with a corresponding drain on already low general funds.

Our first year's operation was confined to Lafayette where we dug in and gave a good service. In a relatively short time, surrounding parishes requested AASI membership service in their areas. So, during the last three years, we have had a rapid expansion from one parish - Lafayette, the medical hub - to ten additional parishes, and we now have a staff of some 120 men, 35 ambulances and a total budget of just over two million dollars.

The second item in the appendix lists 11 parishes and the square mileage, population, and number of family memberships secured in each parish. It is interesting to note that approximately 50% of the total population are members of Acadian Ambulance Service and these members tend to use AASI vehicles more than non/members, who would have to pay \$50.00 for a transfer or \$55.00 for an emergency. Ordinances in each parish require that we respond to all emergency medical calls, asking no questions in terms of member or non/member until the patient has been delivered to the hospital of choice. At that time, if the patient is a member, no charge is made for the call. If it was a non/member call, every effort is made to collect the non/member call rate. Rates cannot be altered unless approved by the governing agency - in our case, the police jury which regulates our operation. No other emergency medical agency can provide service without seeking the approval of the local health planning council which entails a certification of need for additional service in AASI area, which is shaded on the map.

Our base operation is in Lafayette Parish. We have multiple unit substations in the major communities of 30,000 or more population and in areas of less than 30,000, we station one ambulance to cover a 20-25 mile rural area. Should that ambulance have to leave that given area, a unit from the metropolitan station would move into the vacant area to provide back-up. Substations usually consist of a mobile home adjacent to the community hospital. Crews work 48 hour shifts on and 48 hour shifts off, and are available by radio and pager throughout the 48 hour shift. They must stay together with their ambulance during the 48 hour shift. We have five areas of operation, spread out along Highway 90 and Interstate 10, that have multiple unit capabilities with an additional 10 satellite substations in the outlying areas where one ambulance protects communities of from 5,000 to 20,000 people.

Our terrain is marshy and swampy. Our ambulances sometimes go by pontoon bridge or by ferry to reach remote areas. Our first units were Pontiacs and Cadillac Superior Coaches. We later used the Superior wide vans and the vans produced by a number of other ambulance manufacturers. Our decision now is to have our entire fleet composed of Modulance units built by Modular in Dallas. At present, 20 of the 35 units have the modular capability. Yes, they consume more gas and there is a bit more wear and tear on the brakes, but, in the rural areas that we are serving, we believe, if the compartment lasts seven years, the greater initial investment will prove to be more economical in the

long run. The Modulance unit provides more room to work with the patient and has more stability. If the unfortunate possibility of an accident should occur, the staff and patient fare much better in the Modulance unit than in any of the other vehicles we are familiar with. Fortunately, due to a strong defensive driving program, AASI's accident record is minimal.

We log approximately 100,000 miles per month and respond to an average of 75 calls per day. Because our ambulances respond to all emergencies and requests for transfer, they are almost constantly moving throughout the communities, putting them in the best position to serve the emergency needs of a community. All of our units are equipped equally; all have two men aboard at all times. As the cardiac training program advances, plans call for some of the more sophisticated vehicles with telemetry to have three men aboard for specialized transfers from the Lafayette area into Houston and New Orleans.

Wally LeBlanc, a local broadcast engineer, assisted me in the design and construction of our communications system which centers around the Lafayette Dispatch operation. Five dispatchers are on the daytime shift, receiving via WATS lines, all incoming calls within a radius of 150 miles. A tremendous amount of cooperation and excellent rapport between AASI and the telephone company let to tariff changes that enable operators to connect distressed emergency parties to the WATS line system (previous tariffs prohibited an operator from handling a WATS call).

We have four incoming state WATS lines in rotary. An individual may dial the operator, and she will connect him to the system or he may dial direct. In no case will it take more than 25 seconds after an operator has been dialed for her to connect the caller to our system. In effect, for the last year, this WATS system has proved to be most efficient in overall control and organization of the ambulances.

AASI has five transmitters at points along the Louisiana Gulf Coast, from Houma to Lake Charles. These five stations, on antenna towers from television or oil company towers, range from 500 to 800 feet high, giving us magnificent reach with overlapping coverage and bigger pager performance. In the rural areas, we feel this system provides much better response time in an emergency.

The calls come into the Lafayette Dispatch Center by WATS lines and are distributed through the command console system to the various ambulance substations and crews. In the Dispatch Center, there is one chief operations manager in charge of all of our minute by minute proceedings. Working under his direction are four dispatchers who know the exact location of each ambulance, if enroute, its destination and the next call coming in. Everything is tape recorded and documented through computerized time cards. Because we serve a bi-lingual section where many of the Acadian (Cajun) people over 60 speak only French, it is a prerequisite that our dispatchers be bi-lingual.

There is a crossband communications system between Acadian Ambulance Service and all the sheriff's offices as well as the major city police departments and State Police. This is an important people-to-people communications link and has contributed much in terms of cooperation among the agencies and AASI. In the past, one agency could not call another without going through a phone system; now

every authorized agency has monitors on every other authorized agency's frequencies. All frequencies are muted. When you desire a certain agency, you simply press a 1,000 cycle tone which sets off just that individual's radio and you communicate back and forth on each other's frequencies.

After the Dispatch Center has dispatched the ambulance, and the patient has been stabilized, the medic encodes, through a five digit number, the destination hospital on a second statewide common frequency of 155.340. The hospital can then prepare for the incoming emergency by having physicians and nurses ready for the incoming victim. This can be particularly important in life and death situations and in rural hospitals where, normally, the emergency room does not have physicians or nurses on duty.

Future plans are for two additional telemetry channels, such as Houston has done on the 450 megacycle band with the repeater system in the ambulance. AASI has one pilot unit now transmitting telemetry. It has been very successful, but is very expensive. We hope to secure some type of outside help to expand this feature of our service. Otherwise, we will give thought to increasing membership and non/member rates to cover the added costs. We believe telemetry is essential, particularly in some of the rural areas we are serving where the patient could require critical care during the first few moments of cardiac problems.

Public relations are important - whether you have a private or public ambulance service. How well the people accept the service, and how well the local political factors and medical community accept the service are vitally important to the success of emergency medical services. Attached are several newspaper clippings testifying to some of the support our private service has received in Southwest Louisiana.

Community attitude is an equally important factor in the acceptance of any emergency medical system. At Acadian Ambulance Service we place a great deal of emphasis on pleasing the public, not because we are the sole provider, but because we must go back to these people on an annual basis and win a continued vote of confidence through renewal of family and individual memberships and payment of \$18.00 to assure the community of ambulance protection.

We have been able to sell the membership concept not as insurance which it is considered in some states and, therefore, ruled illegal, but as assurance that a family, their relatives or friends would have the protection of our service under unpredictable medical circumstances. According to federal statistics, the average family uses an ambulance only once every 7 or 8 years. Therefore, a family could come out ahead financially by not enrolling with Acadian Ambulance Service at all. On the other hand, without community acceptance of the membership method, AASI would not exist, and there might not be competent service available.

In 1974, according to AASI records, average urban response time was 7.5 minutes from receipt of the call. The average rural response time was 8.4 minutes. These figures reflect a longer response time overall than say, the ambulance division of the Houston Fire Department, which is 5.5 minutes. Company-wide, our average, from the time we receive a call until we arrive at the hospital has been about 22.5 minutes. We placed a great deal of emphasis on stabilizing the patient

rather than on hurrying to load the patient and rushing to the hospital.

Our average per call cost during the last seven months was \$74.64, about double that of the Houston Fire Department's \$42.50. I repeat, we respond to nearly 25,000 calls per year scattered out over 8,600 square miles while they respond to 50,000 calls in a more highly concentrated area.

Item #6, attached, is a list of major parishes we serve with some interesting data. Notice the decreasing number of DOAs at the emergency rooms, which we like to think is due, in part, to the improved service AASI has been able to provide. We are now up to a basic life support system and hope that through pursuance of additional funds, to be able to add the advanced life support system involving additional cardiac equipment and properly trained staff. In the chart you will also see a decrease in the DOAs from 1971, '72, '73 and '74. Part of that decrease in '74 can, of course, be accredited to the reduced speed limit.

One final point in any discussion of private versus public ambulance service is that public services are usually more readily awarded federal and state grants. I feel private services are somewhat discriminated against in this area, and should be judged on merit and public disclosure of certified audits of their operation which we do in our area. Private services can be more efficient through quick decision making and, hopefully, are somewhat less involved in politics than public services, but the larger the private service, the more involved the politics, internal and external. In fact, we sometimes wish we had all minored in political science.

In summation, it is difficult to say which can provide the better emergency medical transportation service - a private corporation or public agency. In our membership campaigns, we have described AASI as rendering a public service through private enterprise, a concept which evidently makes a lot of sense to our industrious Cajun society. But, generally, there is a trend toward public services assuming control due largely, I think, to the fact that some private services failed to render satisfactory service because they did not have sound financial structures.

I am convinced that under the right circumstances, with in-depth understanding of the area to be served, proper fiscal and personnel management, support of community leaders and high standards of performance, the ambulance service in any geographical area, be it public or private, can be successful in terms of solvency and service to the people.

A detailed map of Louisiana showing its parishes and major cities. The map is oriented with North at the top. The Gulf of Mexico is visible on the right side. Major cities like New Orleans, Baton Rouge, and Shreveport are marked. The map is divided into numerous parishes, each labeled with its name. The state's outline is clearly defined against the background.

**SERVING OVER 580,000 RESIDENTS
OF SOUTH LOUISIANA;
ENCOMPASSING
NEARLY 9,000 SQUARE MILES.**

FIGURES EFFECTIVE SEPTEMBER 1, 1974

<u>PARISH</u>	<u>MEMBERS</u>	<u>SQ. MILES</u>	<u>PEOPLE/SQ. MILE</u>	<u>POPULATION</u> **
Lafayette	14,284	279	420	117,100
Vermilion	8,080	1,416	32	44,876
St. Mary	8,275	1,036	59	60,752
Acadia	8,423	656	79	52,109
Jefferson Davis	4,649	653	46	29,778
Eunice Area	3,541	126	202	25,457
St. Martin	5,802	831	39	32,453
Terrebonne	8,706	1,893	42	79,212
Thibodaux Area	5,821	265	171	45,343
Iberia	4,689	820	70	57,397
Evangeline	<u>3,972</u>	<u>699</u>	46	<u>31,932</u>
TOTALS	76,242	8,674		576,409

**Based on 1970 Census

FIGURE 1-L.H.A. COMMUNICATION SYSTEM
ACADIANA AREA

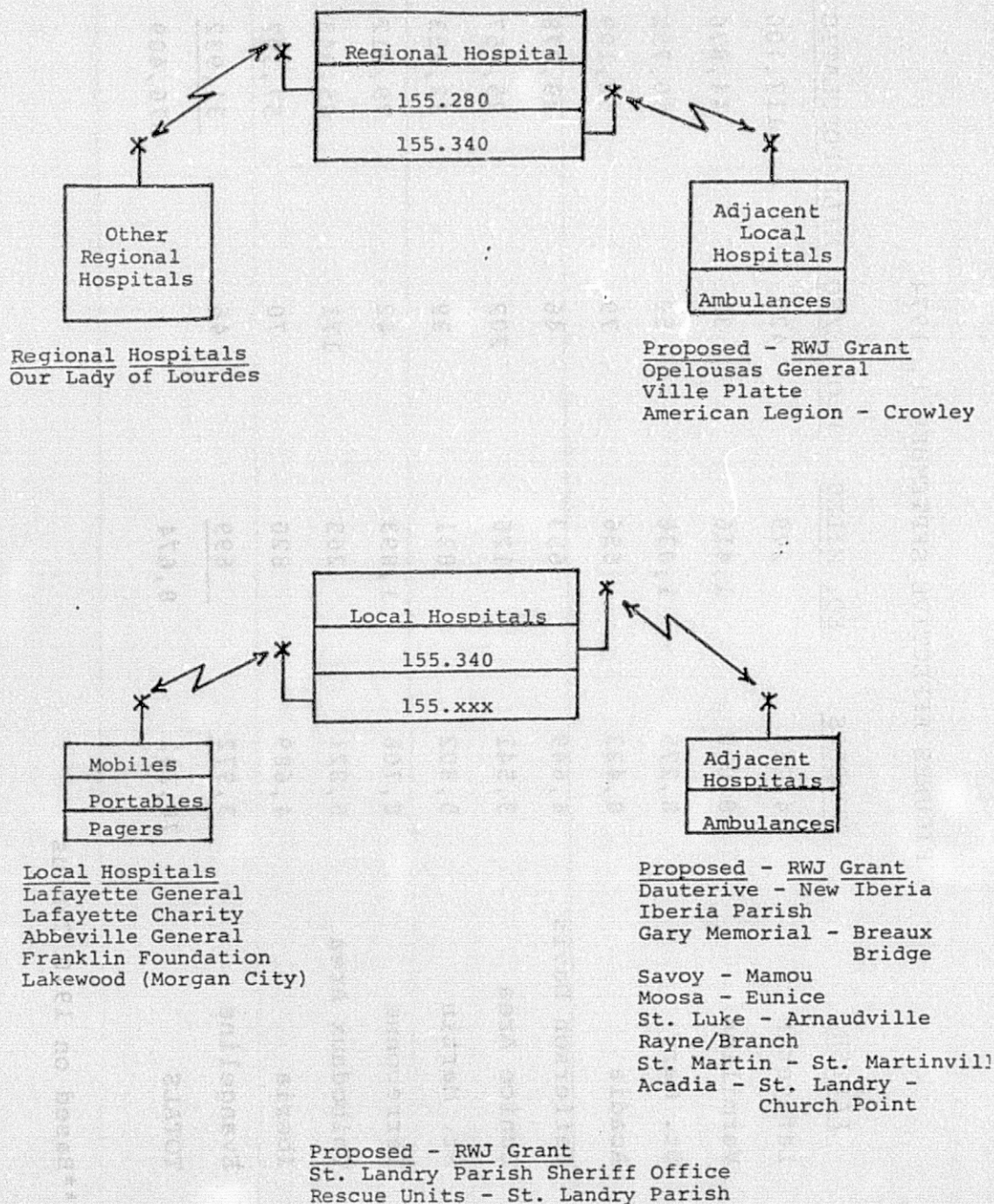
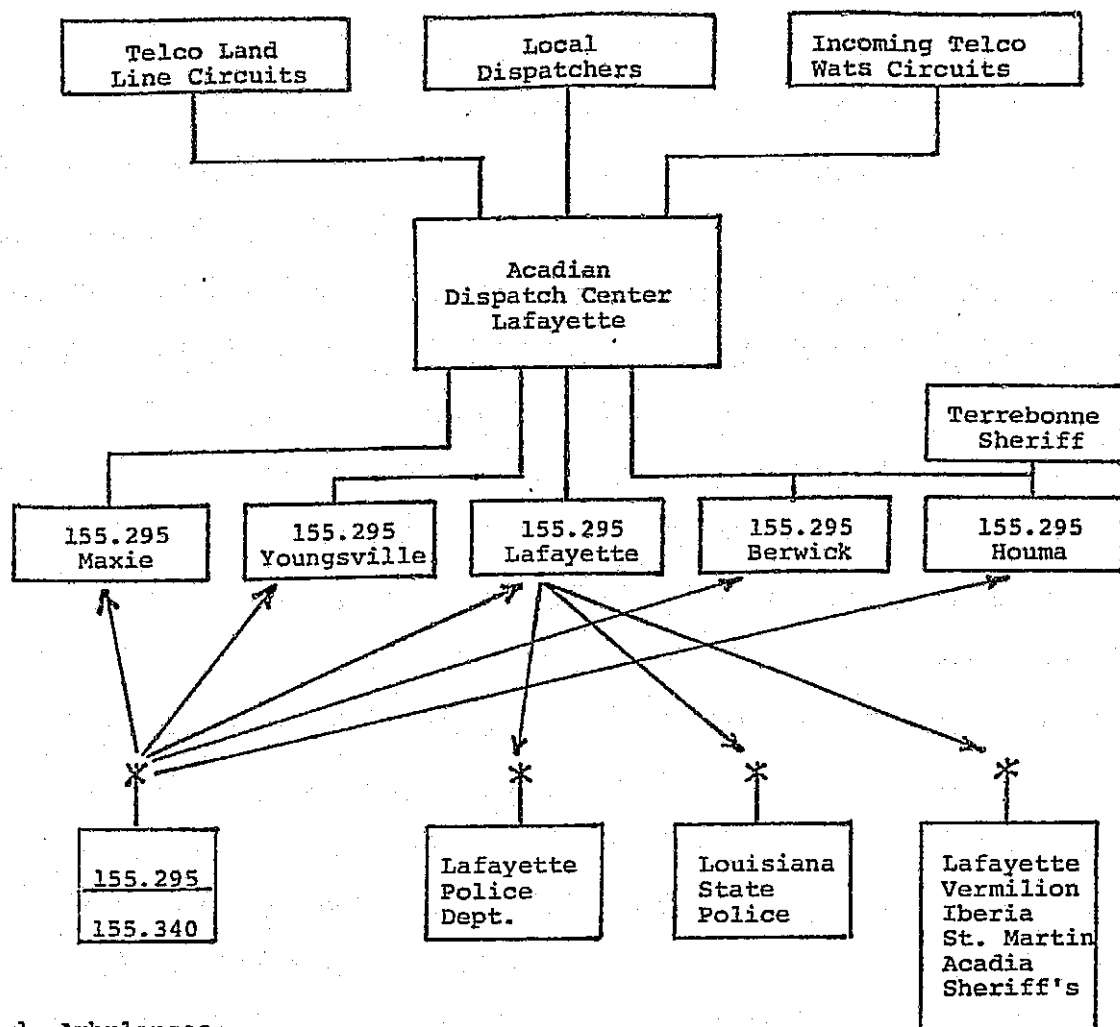


Figure 2 - ACADIAN AMBULANCE COMMUNICATION SYSTEM



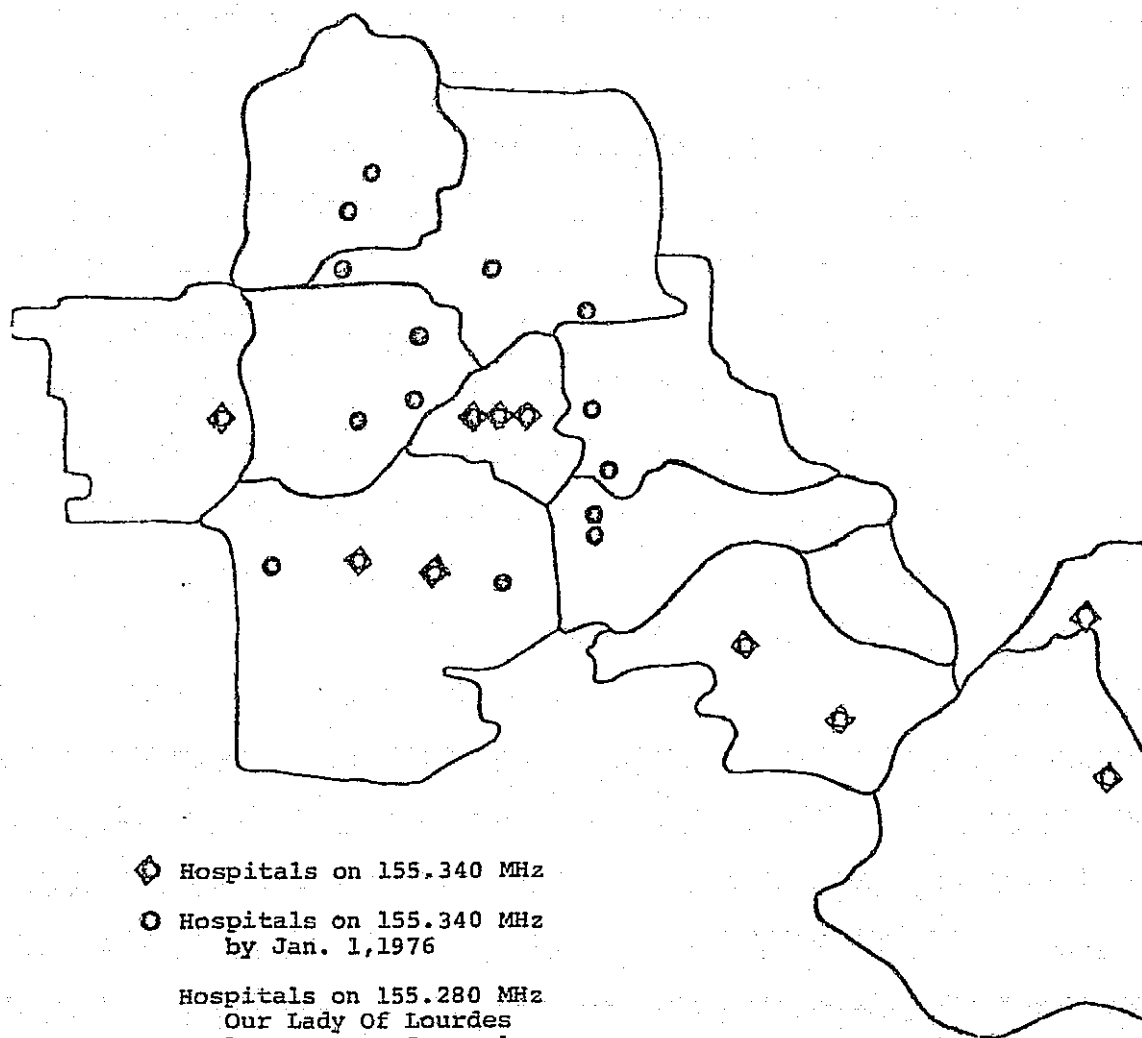
1. Ambulances
(30 strategically located throughout Acadian Service area)

2. Handheld Portables for Supervisory Personnel and on the man communications.

PROPOSED ADDITIONS

Jeff Davis Sheriff
St. Mary Sheriff
Evangeline Sheriff
Eunice Police Dept.
Thibodaux Police Dept.

Figure 3- HOSPITALS



◆ Hospitals on 155.340 MHz

○ Hospitals on 155.340 MHz
by Jan. 1, 1976

Hospitals on 155.280 MHz
Our Lady Of Lourdes
Baton Rouge General
Lake Charles Memorial

Hospitals Proposed for 155.280 MHz
Opelousas General
Crowley American Legion
Lakewood Hospital

NUMBER OF DOAs RESULTING FROM TRAFFIC ACCIDENTS

<u>PARISH</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Acadia	23	19	23	12
Iberia	14	15	19	11
Lafayette	32	34	21	14
St. Martin	17	16	8	12
St. Mary	23	21	22	17
Vermilion	<u>12</u>	<u>17</u>	<u>14</u>	<u>6</u>
	121	122	107	72



EDITOR'S CORNER

By
Charles Lenox

\$1.5 MILLION BARGAIN

It's not easy to raise \$1.5 million in one month but it is probably going to be done by Acadian Ambulance Service and Lafayette and Acadiana will be the ones which gain the most.

Acadian Ambulance is moving into the final week of its annual membership drive and if membership quotas are reached in all areas, the ambulance service will have raised \$1.5 million in membership fees. Judging from expert opinion, Acadiana is getting a bargain.

Acadian came into being in September, 1971 when local funeral homes went out of the ambulance service business because of soaring costs. They started with eight men and two ambulances and as of December, 1973 the service has grown to 22 emergency vehicles and 94 employees, serving 6,345 square miles and 486,980 persons.

TRAINED PERSONNEL

Prior to Acadian Ambulance Service, most of Acadiana had ambulances staffed with inefficient, untrained personnel and unsound emergency equipment. This changed quickly when Acadian came into being.

Acadian hired the best trained emergency personnel, former medics coming in from Vietnam, who, at that time, were finding it very difficult to locate a good paying job.

These men had the combined training and knowledge with a sincere desire to work, and Acadian had the need for such talent, a situation where both parties were helping each other.

Now Acadian is helping coordinate emergency medical technician classes throughout the nine-parish area. Of the current 94 employees, 33 men have complete the EMT training and an additional 47 are in training at this time.

COMMUNICATIONS SYSTEM

Richard Zuschlag, one of the owners and a former communications engineer, has developed one of the most complex communications systems in the entire South.

All calls come into the emergency medical dispatch center in Lafayette via toll-free phone lines. From there, dispatchers have direct mobile radio contact with each of its 22 ambulances; all 11 substations in the 100-mile radius; most major hospitals; State Police Troop I; Lafayette City Police; Sheriff's offices in Lafayette, Vermilion, St. Martin, Acadia and Terrebonne Parishes.

One of the biggest strides to come not only into Louisiana but to the South, has been the introduction of the Cardiac Modulance, a truck-type unit capable of transmitting electrocardiograms from a moving ambulance to a hospital. While en route, the specially trained medic on board can administer the proper medications for the cardiac patient.

This has to mean something when you consider that 38 per cent of all deaths in 1973 were due to heart attacks.

GREAT COOPERATION

Acadian Ambulance has been a leader but only through the splendid cooperation of Lafayette hospitals and the medical profession has the entire life-saving process become a reality.

Lafayette and Acadiana have come out the dark ages into some of the most advanced emergency care available in the United States.

Conversations with experts in the field of emergency ambulance service will not call the service provided by Acadiana Ambulance the best in the United States. But they will tell you if it is not the best, it is at least second.

COMFORTING THOUGHT

When Acadian Ambulance came into being, there were many skeptics and this writer was among them. But if the first three years of service from Acadian are indications of things to come, then no one has any worries.

If you or a member of your family becomes involved in an accident there is much greater chance that you will survive in Acadiana because Acadian Ambulance is answering the emergency call.

This has to be a comforting thought for all Acadiana citizens.

Acadian Ambulance drive raises company to No. 1 in U.S.

Acadian Ambulance Service officials said today their recently completed membership drive was a success. Richard Sturlese, AASI vice president, said response to the campaign makes it possible for the firm to continue full service to members in previously-enrolled parishes, and to inaugurate service to new members in Iberia and Evangeline.

"We have reached a milestone with this campaign," Sturlese said. "With a total membership of 76,242 people, we are now the largest private rural ambulance service in the nation."

"Unfortunately," Sturlese said, "we saw enrollment drop in some parishes."

"While this was disappointing, it will not mean a corresponding drop in the quality of services we offer. It will, however, mean that some of our plans for expanding services will not be realized as soon as we had hoped. For instance, we will not immediately acquire as many units equipped to transmit electrocardiograms to hospitals while rolling, as we had planned."

"But all services now offered will be continued in full."

Sturlese said AASI officials feel that the present state of the economy may have contributed to the decline in memberships in some parishes.

Roland Dugas, AASI president, said he was very pleased that Lafayette Parish again showed an increase in enrollment. "This is where we started," Dugas said, "and these are the people who know us best."

"We appreciate their continued confidence."

Dugas noted that when the company began operating in Lafayette in September, 1971, it had two ambulances and eight men.

"Since then," he said, "we have expanded to 116 employees and 30 ambulances. Fifty-two per cent of the Acadiana population is now included in our membership."

Dugas said another successful membership campaign means "we can continue to meet the high standards we have set for ourselves."

"We will continue to operate with highly-trained registered Emergency Medical Technicians, who now comprise 75 per cent of our employees, and we will continue to provide these skilled medics with the best in equipment."

"While the membership decline in some parishes affects our plans to greatly increase the number of Cardiac Modulance Units in our fleet, we will make some strides in this area in the coming year."

"A private foundation was sufficiently impressed with these truck-type units from which EKGs can be transmitted to the hospital while rolling, that some funds will be made available for this purpose."

"We are very enthusiastic about the Cardiac Modulance procedure. We were the first to employ it in Louisiana and second in the South."

"With it, a doctor at the hospital reads the EKG, and through radio contact with the moving ambulance, prescribes medication which our technicians are capable of administering," Dugas said.

Richard Zuschlag, secretary-treasurer of AASI, said the company officials feel it is important "that our members know they are getting more than just access to a fast moving vehicle with a siren and flashing lights."

"Besides the trained medics and the ultra-modern equipment," he said, "we have one of the most effective communications systems in the entire South."

"Frequently, good communications make a life-or-death difference in an emergency medical situation."

Zuschlag, a former communications engineer with Westinghouse, designed the complex system. Located in Lafayette, it receives calls through fourteen telephone lines, six of which are toll free from anywhere in the State. Information taken by phone is distributed immediately to ambulances in any of the eleven member parishes.

"Our dispatchers in the communications center," Zuschlag said, "have direct mobile radio contact with each of our 30 ambulances, all 15 sub-stations, most major hospitals, State Police Troop I, Lafayette City Police, and Sheriff's Departments in Lafayette, Vermillion, St. Martin, Iberia, Acadia and Terrebonne Parish."

In areas where hospitals have not yet purchased radio equipment, Zuschlag said, dispatchers can phone an emergency room, and by complicated electronic relays, put a doctor or nurse in contact with medics in an ambulance en route to the hospital.

"Our medics then provide information on the condition of the patient."

"The dispatchers in our communications center speak both French and English. We require that they visit the various service areas, so that they will be better able to direct the ambulances to their destinations," Zuschlag said.

The Acadian Ambulance Service membership fee covers a year of emergency ambulance service throughout the eleven parish area. It also provides for doctor-authorized transfers of a non-emergency nature in the parish where a member resides. Non-members are charged \$55 for each emergency call and \$50 for each transfer.

After the August membership drive closes each year, no more members are accepted except for new residents moving into the area.

However, AASI officials say they are considering a request from Iberia Parish residents that this year's drive be reopened. "There was a great deal of confusion during the campaign," said Dugas, "and it is possible that the people deserve another opportunity to join."

Following are membership figures resulting from the recently-completed campaign: Lafayette, 14,284, an increase of 855; Vermillion, 8,060, a drop of 40; St. Martin, 5,802, a drop of 297; Acadia, 8,423, a drop of 180; Jeff Davis, 4,649, a drop of 516; St. Mary, 8,275, a drop of 952; Eunice, 3,541, a drop of 319; Thibodaux, 5,821, a drop of 788; Terrebonne, 8,706, a drop of 830; Iberia (new), 4,689, and Evangeline (new), 3,971.

CEREMONIES HERE

Edwards Opens Facilities Here

Governor Edwin Edwards was the keynote speaker as the new emergency medical services center and facility of Acadian Ambulance Service, Inc., was dedicated in ceremonies yesterday at 300 Hopkins St.

The ceremonies coincided with the launching of AASI membership campaigns in 11 connecting southwest Louisiana parishes.

Edwards referred to the success of the ambulance service membership plan concept as proof that trust and technology go hand in hand.

He said, "The people of Acadian are fortunate to have this critical, essential public service managed by optimistic, dedicated and educated young

men, staffed with energetic, reliable war veteran or locally trained medics, equipped with the best mobile medical vehicles technology has produced, and most important of all, operated on a sound financial plan structured through public membership."

Feel Safe

Edwards said all Acadian citizens "can feel safe knowing they have parish - to - parish protection in the face of ever-growing hazards to human life."

Congressman John Breaux congratulated the Ambulance service industry which serves all the people of Acadian.

Referring to the emergency

(Continued On Page 2, Col. 4)



DISCUSS COMMUNICATIONS — Gov. Edwin Edwards, center, listens as officials of Acadian Ambulance Service here discuss the communications system at the new

services headquarters dedicated here yesterday. The governor and U.S. Rep. John Breaux were among dignitaries on hand for the occasion. (Advertiser Staff Photo)

ORIGINAL PAGE IS
OF POOR QUALITY

Edwards Opens Facilities For Ambulance Service Here

(Continued From Page 1)

service Breaux said, "Its great. Its going to get even better."

Following the invocation, delivered by Msgr. Harry Benefiel of Broussard, Thomas Pears, president of the Lafayette Chamber of Commerce, introduced Edwards, Robert Merkel of the Louisiana Hospital Association, and other special guests seated with the governor.

Merkel extended greetings for the various offices, agencies, and facilities at state, regional, and local levels that make up the health industry.

'Old Days'

In recalling how accident and acutely ill patients were handled in the "old days" prior to federal regulations governing emergency medical services, Merkel said:

"Our grandparents, parents, all of us except perhaps the very young, were grateful to the funeral home owners who could be depended upon to take victims to medical facilities. Progress in medicine, changes in population composition and mobility, and technical advancements mandated a new method of delivery. The ac-

ceptance of the AASI Membership Plan in nine parishes and two hospital districts makes it apparent the people of Acadiana have confidence in the emergency medical system adopted first by Lafayette Parish in 1971."

Merkel announced the approval of a \$318,000 federal grant to further increase emergency medical services in Lafayette and the 8-parish area.

In ribbon cutting ceremonies officially dedicating the new facility, Edwards commented upon the opportunity ambulance service employes have to serve mankind and themselves.

He noted AASI's parallel increases in memberships, from 8,400 in 1971, to 75,000 in 1973, and size of personnel staff, which has grown during that time period from eight to 100 employes with a current payroll of over one million dollars budgeted for fiscal year 1974-75.

Special Guests

Special guests at the dedication were Arthur Vidrine, M.D., and Lafayette Parish Medical Society president, Ler Brown, executive director of the Louisiana Hospital Association, and Lafayette Parish Police Jury President, Walter Comeaux.

Distinguished out-of-town visitors included Chief Whitey Martin, Ambulance Service, Houston, Tex., Fire Department, and Ken Thompson, president of Modular Ambulance Corporation, Dallas, Tex.

A helium filled balloon carrying a mini-ambulance was launched by the governor to open the 11 parish campaigns. Symbolic of the Emergency Medical Service protection rendered by AASI, covering a geographic area of over 6,000

LAFAYETTE, LA., TUESDAY, JULY 31, 1973



TELEMETRY SERVICE — A host of local and area officials were on hand for inaugural ceremonies of a new telemetry radio system which will enable Acadian Ambulance Service to transmit electrocardiograms of heart attack victims to any of the three major hospitals in Lafayette. Explaining the mechanics of the new system to hospital officials was Richard E. Zuschlag, (seated, left) secretary - treasurer of the ambulance service. Also pictured in the ambulance are (from left) Richard M. Stur-

lese, Acadian Ambulance Service official; Dr. Dan Voorhies, Lafayette Charity Hospital administrator; Don Hebert, Our Lady of Lourdes Hospital administrator; and William Carroll, Lafayette General Hospital administrator. Posing as the patient is Danny Lennie, an emergency medical technician for the ambulance service. Acadian Ambulance kicked off its August membership campaign in each of the five parishes it serves today. (Staff Photo by Peter Piazza)

Ambulance Begins Telemetry System

By DAVE PRECHT
Advertiser Staff Reporter

Victims of heart attacks will receive an extra break in Lafayette parish now that Acadian Ambulance Service has begun using new and unique telemetry equipment, which enables ambulance medics to transmit patients' electrocardiograms from ambulances to any of the three hospitals in the city.

The new service was inaugurated in ceremonies today at the Lafayette Parish Courthouse, which highlighted the kickoff of the ambulance service's membership campaign.

First In State

With the telemetry system in operation, Lafayette became the first city in Louisiana and the second in the South in which cardiac patients are afforded the extra life supportive means in emergency care, according to Richard E. Zuschlag, secretary - treasurer of the ambulance service.

Host for the kickoff activities was Walter Comeaux, president of the Lafayette Parish Police Jury. Also on hand were Lafayette Mayor Kenny Bowen, and police jury presidents and mayors of municipalities in Lafayette, Acadia, Jefferson

(Continued On Page 6, Col. 4)

Davis, St. Landry, and St. Martin Parishes, where membership campaigns for the ambulance service are also scheduled from Aug. 1-31.

Commenting on the new system, Comeaux said he was proud that Lafayette Parish is becoming "first in the state, and second in the South in emergency rescue services." He added, "I hope this (telemetry) will be expanded into rural areas of surrounding parishes which Acadian Ambulance Service also covers."

Bowen also praised the new measure at a meeting of governmental officials and ambulance service officers in the Police Jury Meeting Room of the parish courthouse at 10 a.m. today. "This is another move forward in the human services area for people of our community." And he said it "reflects again the creative thinking and leadership of the medical profession which has undertaken the training of medics who will man the cardiac rescue system."

Ambulance Starts Telemetry System In Lafayette, Area

(Continued From Page 9)

Radio Relay

Radio Relay — AASI Vice President, Richard Zuschlag commented in a Sturlese, who managed the prepared statement, "Telemetry campaign in St. Mary Parish, tells the story — rapidly, stated he expected quotas to be exactly, and in transit through met or exceeded based on the radio relay the patient's EKG company's experience in can be transmitted within a Lafayette and Vermilion radius of 45 miles from the parishes and the enthusiasm of special cardiac unit vehicle to leaders in the communities any of the three major Lafayette hospitals. With the advance information, available at AASI serviced territory.

Other Juries

monitoring equipment, a physician will have visual evidence of the patient's condition prior to arrival." NASI proposals; however, the

The telemetry system will be company, for the present, will be available in the special cardiac unit emergency medical unit purchased by Acadian transportation service to Ambulance earlier this year. Acadiana.

The Federal Communications Commission has granted an experimental license for the pilot telemetry service employing general electric radio equipment and medtronic monitoring devices. Costs of receiving center equipment and maintenance were assumed by each of the three Lafayette hospitals who worked closely with AASI to achieve synchronization. Zuschlag explained.

Trained Technicians

Three emergency medical technicians, trained by a physician advisory group, composed of cardiologists and internists, will man the cardiac unit, he added. Similar units in other areas served by AASI will be deployed as membership plans become "firmly established", he predicted.

According to Zuschlag, the membership goals for Lafayette Parish is 12,000; for Vermilion, 7,000. Quotas for new parishes desiring ASSI coverage are: Acadia, 5,500; Jefferson Davis, 4,000; St. Landry (Ward 6) 3,500; St. Martin, 4,000. Added to the 9,600 memberships subscribed in St. Mary Parish in November, 1972, anticipated total enrollment in the six areas is 45,600.

Main and branch banks in all campaign areas will act as membership receiving centers. In the initial campaign areas collections will be held in escrow. If quotas are met, ambulance service will begin September 1. If not the banks will make refunds in exchange for provisional membership cards issued at purchase. In Lafayette and Vermilion parishes membership cards become valid upon payment of the \$15 membership fee.

AASI Vice President, Richard Sturlee, who managed the campaign in St. Mary Parish, stated he expected quotas to be met or exceeded based on the company's experience in Lafayette and Vermilion parishes and the enthusiasm of leaders in the communities hoping to become part of the AASI serviced territory.

a According to Zuschlag, a number of other Louisiana parish police juries have requested AASI proposals; however, the

the company, for the present, will limit emergency medical transportation service to Louisiana.

is. Lafayette citizens may obtain information about the membership plan by calling 232-1511. In other areas where campaigns are underway, residents may call toll free 1-800-252-5522. This toll-free line has been designated as Louisiana's emergency medical telephone number for covered parishes other than Lafayette, in an arrangement made possible through the cooperation of South Central Bell which is in keeping with a major recommendation of emergency health care experts at the national level that an emergency medical dispatch center "call number" be available to the general public.

As the emergency medical dispatch center (EMDC) Lafayette will be the focal point of incoming calls. All local telephone operators in covered areas when dialed under panic or stress conditions will have access through special trunk lines to EMDC.

Ninety emergency medical technicians (EMTS) man 20 AASI ambulances dispatched from the Lafayette headquarters. Present substations are located in Kaplan, Abbeville, Franklin and Morgan City. Scheduled for activation September 1, contingent upon membership quotas being reached in the initial campaign areas are substations in Jennings, Crowley, Rayne, Eunice, and Breaux Bridge.

Regional managers are Daniel Domingue and Thomas Duhon, both of Lafayette.

KVOL EDITORIAL
MONDAY, AUGUST 5, 1974

OVER THE WEEKEND, WITH MUCH FANFARE, ACADIAN AMBULANCE SERVICE, INC. OFFICIALLY DEDICATED IT'S NEW OPERATIONS HEADQUARTERS IN LAFAYETTE, AND AT THE SAME TIME, KICKED OFF IT'S 1974-75 MEMBERSHIP DRIVE THROUGHOUT ACADIANA. ACADIAN AMBULANCE IS ONLY THREE YEARS OLD, BUT IT CAN TRULY BE SAID THAT IT HAS LED THE WAY WHEN IT COMES TO EMERGENCY MEDICAL SERVICES. THINGS THAT ARE BECOMING MANDATORY BY LAW FOR AMBULANCE SERVICES WERE IN OPERATION AT ACADIAN LONG AGO. ACADIAN LED THE WAY WITH THE USE OF TELEMETRY TO SEND BACK SIGNALS WITH THE LIFE SIGNS OF EMERGENCY PATIENTS. AND AS HAS BEEN SAID MANY TIMES, ALTHOUGH YOU HOPE YOU'LL NEVER HAVE TO USE IT, THE AMBULANCES AND PERSONNEL ARE THERE JUST IN CASE. AND WHEN YOU DO NEED THEIR SERVICES, YOU CAN BE SURE IT WILL COME QUICKLY, AND YOU WILL GET IMMEDIATE ATTENTION, NOT JUST A RIDE TO A HOSPITAL. ACADIAN AMBULANCE HAS GROWN, FROM LESS THAN NINE THOUSAND MEMBERS TO OVER SEVENTY THOUSAND. AND AS THE SERVICE IS EXPANDED TO TAKE IN MORE TERRITORY, THE NUMBER OF MEMBERSHIPS IS EVER GROWING. WE WOULD LIKE TO ENDORSE THIS YEAR'S MEMBERSHIP CAMPAIGN AND URGE EVERYONE TO ENROLL IF YOU HAVEN'T ALREADY DONE SO. IF YOU HAVE TO MAKE USE OF AN AMBULANCE ONCE IN THREE YEARS, YOUR MEMBERSHIP WILL HAVE PAID FOR ITSELF. IF YOU EVER AT ANY TIME IN THE FUTURE HAVE TO MAKE USE OF THE AMBULANCE SERVICE, THE VERY FACT THAT WITH YOUR MEMBERSHIP YOU HELPED THE SERVICE STAY IN OPERATION WILL WELL BE WORTH IT. ACADIAN AMBULANCE SERVICE IS AN ASSET TO ACADIANA, AN ASSET THAT SHOULD BE APPRECIATED, BECAUSE IT INDEED IS A LIFE SAVER, AS MANY PEOPLE CAN ATTEST TO.

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MILITARY ASSISTANCE TO SAFETY AND TRAFFIC

CAPTAIN HERBERT A. COLEY

Of all the advancements made by the military in recent years, none is more significant than those made in the medical service of the United States Army. One of the major factors prompting the improvements of this service is the introduction of the helicopter into the patient delivery system. The utilization of aircraft for the transportation of patients is not doctrine originating with the Army, but it does provide a solution to the two most serious problems in evacuation, those of time between the initial injury and the physician and the limitations imposed by terrain.

Historically, the first recorded use of aircraft to evacuate patients was by balloon during the siege of Paris in the Franco-Prussian War. As early as 1910, the United States examined the feasibility of moving patients by air, but the idea was discarded as being impractical. Although aircraft were utilized in isolated instances during World War I, there was no prepared system for aeromedical evacuation until World War II. During that conflict, patients were airlifted primarily by fixed wing aircraft from fixed airfields. Although this system enabled the patient mortality rate to be significantly reduced, the evacuation of patients from the initial site of the injury directly to a physician was still hampered because the airplane could not completely divorce itself from the obstacles imposed by terrain.

The introduction of the helicopter into the Army's aircraft inventory added a new dimension to aeromedical evacuation. By the beginning of the Korean conflict, helicopters were available that could be equipped to transport patients. The patients, however, were transported in external pods where they were exposed to the elements and their condition could not be monitored or treated enroute. Because the merits of helicopter evacuation had been proven in Korea, research and development efforts resulted in the availability of a more effective helicopter for use in Vietnam. The UH-1 helicopter, manufactured by the Bell Helicopter Company in Fort Worth, Texas,

MAST Project Officer, 507th Medical Company (Air Ambulance)
Fort Sam Houston, Texas 78234

was developed primarily as an aeromedical evacuation aircraft and introduced into the conflict for that purpose. The UH-1, or "Huey", overcame the limitations imposed by terrain, had an inclosed cabin to carry patients and space for a medical aidman to provide enroute monitoring and treatment. The success of the helicopter's role in the patient delivery system utilized during the war in Vietnam can be measured by the thousands of lives saved.

Rapid patient delivery has always been a concern to those in the health care profession. Having seen the results of the helicopter ambulance in the combat role, the Departments of Defense, Transportation and Health, Education and Welfare began to study the feasibility of utilizing military helicopters and service paramedical personnel to respond to civilian medical emergencies. Studies indicated that military helicopter air ambulance units were ideally suited to supplement civilian emergency medical systems. Early in 1970, the San Antonio area was chosen as the first site to test the Military Assistance to Safety and Traffic Project. MAST, the project's acronym title, was initiated at the request of the civilian community under the local guidance of the Alamo Area Council of Governments. Before MAST could be implemented, coordination with the Alamo Area Council of Governments, the Texas Department of Public Safety, the Texas Civil Defense Agency, local law enforcement officials, doctors and hospital administrators was necessary. The discussions were both educational and directive in nature. Included in the discussions were helicopter operating characteristics and limitations, the need for an effective communications system and the type of patients to be evacuated. In order to request a MAST mission, it was determined that there must exist a serious medical emergency. By definition, this is a situation in which an individual's perceived condition requires air transportation to a medical care center, or air transportation of medical materiel or personnel as quickly as possible in order to prevent death or the aggravation of illness or injury, and in which the use of normal ground transportation will not accomplish that result. With the program planning stage complete, announcement of Project MAST was made by the Secretary of Defense, Melvin Laird, and the Secretary of Transportation, John Volpe, on 15 July 1970. With this announcement, the 507th Medical Company (Air Ambulance) located at Fort Sam Houston in San Antonio initiated MAST in a test phase which was to be conducted from 15 July through 31 December 1970. Shortly after the project began in San Antonio, four other test sites were selected to participate. They were Fort Carson, Colorado; Fort Lewis, Washington; Luke Air Force Base, Arizona; and Mountain Home Air Force Base, Idaho. In January 1971, the MAST Interagency Study Group recommended that Project MAST be continued at the five test sites until a Stanford Research Institute study could be completed and evaluated. The study was completed in September 1971 with the same recommendations for continuation. As a result of these findings, plans were underway to expand MAST to those sites from which formal requests had been received and from which civilian

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officials had demonstrated the capacity to utilize military assets as a supplement to their emergency medical system. Each area was cautioned that MAST was intended solely as an interim supplement to those services provided by other civilian agencies and would not be approved for an area in which the service would be in competition with private ambulance operations.

In November 1973, legislative sanction was given the MAST Program when Public Law 93-155 was signed by the President giving the Secretary of Defense authorization to expand the program to those sites where military medical assets were available. It is significant to note that military units will not be relocated to an area based upon a request to establish a MAST Program. Additionally, MAST services may be discontinued without advance notice based upon military mission requirements and world wide contingencies.

Presently, the 507th Medical Company (Air Ambulance) at Fort San Houston is only one of the twenty-one military units providing MAST support throughout the United States. There are eighteen Army sites and three Air Force sites which provide the service. Current national statistics indicate that as of 2 March 1975, a total of 4,084 MAST missions have been flown, evacuating 4,410 patients, for a total of 9,058 flying hours. As of 24 March 1975, the 507th Medical Company (Air Ambulance) has flown 1,360 missions and evacuated 1,486 patients for a total of 2,183 flying hours. The reasons for success of the program in San Antonio are probably three fold. First, there is the matter of pride in being the original MAST site. Second, San Antonio is a medical Mecca, offering full service medical centers and nationally known specialized treatment facilities. Third, and possibly most important, is the fact that the civilian community has supported the program to the fullest.

In its functional role, the 507th Medical Company (Air Ambulance) is not unlike any other of the units participating in the MAST Program. It maintains UH-1 helicopters on stand by at all times for both civilian and military medical emergencies. The aircraft in its standard configuration can airlift seven patients, three litter and four ambulatory. The organization of the company authorizes thirteen helicopters at Fort San Houston with which to accomplish its missions. Two of these aircraft are on constant alert to support the unit's one hundred nautical mile radius of operations. This area is limited only by the fuel range of the helicopter. Missions will be flown beyond the one hundred mile limit, however, if four criteria are met. First, the death or disablement of the patient must be at stake. Second, MAST must be the only meaningful transportation considering the seriousness of the patient's condition. Third, the requesting physician must attest to the seriousness of the patient's condition and accompany the patient or arrange for other qualified medical personnel to accompany the patient during transfer. Finally, reasonable assurance must be obtained that medical personnel and equipment will be available to receive the

patient at the destination.

To accomplish the MAST mission in the San Antonio area, the 507th Medical Company (Air Ambulance) has a primary and secondary crew on duty each day of the year. Each crew consists of a pilot, co-pilot, medical aidman and crew chief. These crews are available for immediate response and in most cases can be airborne within five minutes after a mission is requested. The most important member of the crew is probably the medical aidman. His capabilities cannot be over-emphasized. Each aidman has received over four hundred hours of medical training. Subsequent to receiving extensive first aid training, he receives instruction and practical training in such subjects as transportation of the sick and wounded, basic anatomy and physiology, sanitation and the prevention of disease, common drugs and their uses, medical symptomatology, field surgery and basic nursing procedures. Once assigned to the unit, aidmen continue their training by attending mandatory, weekly classes. Subjects include pediatrics, gynecology, neonatology and cardio-pulmonary resuscitation. Aidmen also receive flight training to include aircraft orientation, loading procedures, safety and emergency procedures and rescue hoist operation. Even more significantly, nearly all of the aidmen are nationally registered emergency medical technicians. They are professionals capable of handling almost any type of emergency which may arise.

In order for the medical aidman to treat the patients evacuated, there is standard equipment carried aboard each aircraft. This equipment consists of, as a minimum, litters, blankets, oxygen, pressure bandages, pharyngeal airways, IV fluids, tourniquets, wire splints, pneumatic splints, ambu bag, small resuscitator, cardio-beeper and assorted bandages. Special medical equipment is available and may be requested if needed. This equipment can include an incubator, rescue hoist or any other item not normally carried on board the helicopter. The rescue hoist is an invaluable item of special equipment that can be requested when there is no available helicopter landing area within the immediate proximity of the patient pickup site. This hoist has two hundred fifty-six feet of usable cable, stressed for a capacity not to exceed six hundred pounds. Equipment used in conjunction with the rescue hoist can include the forest penetrator, for use in wooded areas, or the rescue basket, for over water recoveries. The rescue hoist is extremely significant in that it adds yet another dimension to the already versatile helicopter.

The Military Assistance to Safety and Traffic Program was designed to provide aeromedical evacuation of patients directly from the accident scenes and inter-hospital transfer of patients when rural or community hospitals lack the equipment or personnel necessary to treat the patient's condition. Inter-hospital transfers can include the transportation of blood, vital organs, special medical equipment or personnel to hospitals where there is

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a critical need. Statistically, more than ninety percent of the missions flown by the 507th Medical Company (Air Ambulance) have been inter-hospital transfers. This may seem inconsistent with the goals of the MAST Program but it is easily explained. As previously mentioned, San Antonio is the home of many outstanding medical treatment facilities. On the contrary, the counties surrounding San Antonio have suffered physician shortages and, thus, have hospitals which in many instances offer only basic medical care. Until recently, the region has had a marginally effective emergency medical service system. The Alamo Area Council of Governments, utilizing funds available through government grants, has so improved the system that it is now considered a model. The MAST program is a part of this system and offers rapid transit for patients who are hospitalized in the region yet are in need of specialized treatment available in San Antonio. Furthermore, many of the requests that would have at one time been accident site pickups are now inter-hospital transfers. This is a result of training, cooperation and coordination with the officers of the Texas Department of Public Safety. Patients who, in the past, remained at an accident scene are now being taken immediately to the nearest treatment facility while the MAST helicopter is being dispatched. This enables the patient to be under medical care from the time of the accident until he reaches the final destination hospital. This approach to emergency medical service is obviously consistent with the total systems concept.

In the case of inter-hospital transfers, coordination must be made by the donating hospital to insure that a physician is available to accept the patient at a receiving hospital. This must be accomplished prior to initiating the MAST request. When no receiving hospital is indicated, for example, on accident site pickups, the patient is taken to the hospital of his choice, if he is capable of expressing a choice, or to the hospital chosen by the attending physician. Otherwise, he is taken to the nearest medical facility with adequate equipment and personnel to treat his condition. To maximize control, MAST missions can only be initiated by either a doctor, hospital administrator, law enforcement official or a San Antonio Emergency Medical Service Dispatcher.

With inter-hospital transfers comprising a vast majority of MAST missions flown, hospital helistop safety is a prime concern. One of the basic tenets of the program requires that participating hospitals maintain helistops which meet standards prescribed by the Federal Aviation Administration Heliport Design Guide. Helistops are constantly monitored to insure that standards are met. The results are obvious in that the 507th Medical Company (Air Ambulance) has never been involved in an accident or incident while on a MAST mission. This record is a result of and indicates the outstanding cooperation received from the civilian community.

The nature of MAST missions in the San Antonio area has changed significantly during the past year. More missions are being flown out of the one hundred nautical mile radius and fewer missions involve the transportation of auto accident associated trauma victims. These trends are probably the result of two factors. First, there is an increased awareness of MAST in the outer areas and an improved civilian emergency medical service system in the San Antonio area. Dependence upon MAST as the only adequate means of transportation has shifted to reliance upon the modular ambulance. Because of the systems approach, however, MAST helicopters are still requested to transport those patients incapable of being moved by ground conveyance. Second, the introduction of the fifty-five mile an hour speed limit coupled with gasoline shortages and exorbitant fuel prices has resulted in fewer serious highway accidents. Increased fuel costs have not only restricted the average citizen's travel, but have also placed restraints upon operation of civilian ambulance services. Although military curtailed its aircraft operations, mission essential flights continued. Funds to operate the MAST program are allocated by the Department of the Army and absorbed within the unit's annually allocated flying and training requirements. Therefore, the program not only operated at a no cost to the civilian community, there was no government expense beyond normal unit operational costs. This makes the MAST Program cost effective not only to the civilian sector but the government as well.

The impetus for support of the Military Assistance to Safety and Traffic Program comes from the local civilian community. The San Antonio area's response to the program has been outstanding. MAST has become an integral part of a fully operational emergency medical service system. The MAST Program, as an additional unit mission, has had no adverse impact on either unit training or operations. On the contrary, MAST missions by their nature, provide a realistic experience for personnel of the 507th Medical Company (Air Ambulance) that cannot be gained otherwise in a routine training environment.

Emergency Medical Services in a Rural Environment

Richard H. Clark, Jr., M. D.

If you are unfortunate enough to have an accident in the Southeast Air Ambulance Service District, the following sequence of events will take place in order to save your life. Notification of the accident and injury will be given to the proper dispatching agency who will determine the proper response and will dispatch this response forthwith. If the proper response be via the air ambulance, an FH 1100 helicopter ambulance will be in the air and on its way within 3 minutes of notification. On board will be two Emergency Medical Technicians, one of whom is the pilot; these gentlemen will administer the proper care at the scene of the accident. Stabilization will take place, following which you will be transported by air ambulance. During this flight the Emergency Medical Technician will be in constant contact with the Emergency Department of the receiving hospital. If instructions are needed as to care these will be given by the Emergency Room Physician and when you arrive at the hospital pad, preparations will have long since begun for your arrival should you be seriously injured. You will be transferred into the hospital emergency room and treated with dispatch and expert care - this in rural and poor southern Mississippi! My story is of the people and process by which this system came to pass.

A number of years ago Hattiesburg and Forrest County were faced with the now age old problem of an ambulance company failing economically and going out of business. This prompted a cooperative effort by the Legislators of the area in the Mississippi Legislature to pass local and private legislation which allowed the city, county, and two hospitals to come together to form a non-profit corporation termed AAA Ambulance Service, Inc. AAA is run by a Board of Directors with representation from these four stockholders who make up the deficit which occurs each year in the administering of emergency care to the citizens of our area.

President
Board of Directors
Southeast Mississippi Air Ambulance District

Then came Project CARESOM, i.e., Coordinated Air Rescue Endeavor, State of Mississippi; this occurred in 1969-70 and was a research project sponsored by the Department of Transportation to determine the efficacy of helicopter air ambulance transportation for the sick and injured. This took place in three areas of Mississippi; one based in Hattiesburg, one based in Jackson, and one based in Greenwood, the projects encompassing roughly a 50 mile radius from these designated areas. The people of Hattiesburg and the surrounding counties were convinced once this project was completed that this mode of emergency care had great potential and with the impetus and thrust afforded by Project CARESOM a group of five counties came together to form the Southeast Mississippi Air Ambulance District. Prior to this formation it was necessary for the Legislature once again to pass laws which made it possible to form this District. A law was passed which allowed two or more counties to levy a tax for the support of same. Five counties (Lamar, Covington, Marion, Jeff Davis, and Forrest) formed the original District which has since added Pearl River and Perry Counties. This District is administered by a Board of Directors made up of members selected by the Board of Supervisors of each county and a Governor's Representative. This Board has the responsibility of seeing that the tax support is properly expended to provide maximum benefit via emergency medical care. This District is totally and solely supported by local taxations of 1/2 to 1 mill per county. Up until a federal grant which was received under the current EMS Law, there were no federal, state, or outside dollars expended for the benefit of this District; it is, as far as we can determine, the only such self-supporting Air Ambulance District in existence. The helicopter is wholly medical. No non-medical duties are assigned except those which allow the ship to be on station and ready for instant service; i.e., environmental and surveillance work. Its main functions are: (1) traffic accident calls; (2) home or work accidents and acute illness calls; (3) interhospital transfers; (4) blood and drug transfer; (5) physician transfer for consultation.

Advantages include the rapidity of placing trained personnel at the scene of injury or illness, the ability to overfly hospitals not offering definitive care for a particular type of patients without time sacrifice, and the short time away from in-hospital care during interhospital transfers.

The legal work involved was completed in 1971. The Air Ambulance District became operational in March of 1972. This District owns and operates an FH 1100 helicopter ambulance 24 hours a day 7 days a week with a pilot and attendant stationed adjacent to the pad. Both the pilot and the attendant are EMT's. The District contracts with AAA Ambulance Company for the emergency care efforts of the air ambulance. In this way the air ambulance and the ground ambulance system throughout the District are coordinated. In service training is almost continuous. Quarters are maintained and administration, personnel, vehicles, and equipment are kept current and operational. This cooperative effort has proved most satisfactory and has afforded many economies to the District, as well as advantages of personnel

coordination and efficiency. The managerial expertise afforded by AAA Ambulance is second to none and Mr. Harvel Smith, Manager of the District and AAA Ambulance Company, has been a prime mover throughout the entire history of this District. In order to better study the intricacies of our emergency care system as it now stands and as it will be, one must study each facet of the emergency care cycle from incident through detection, dispatching, transport, care at the scene of the incident, transportation, and life support through the pre-hospital phase and the care and treatment received in the emergency room and in the hospital itself.

A. Incident and First Aid. In Mississippi until recently first aid was not taught in our public school system. This need was seen by the Mississippi Trauma Committee of American College of Surgeons, Governor's Highway Safety Program, and the Department of Education and a cooperative effort was used to place a program of first aid into our elementary and Jr. high system. This is in conjunction with the safety program. Thereby first aid is being taught to the citizens of Mississippi at the present time and hopefully great benefits will come from this in the near future.

B. Dispatching. At the present time a dispatching capability is maintained at AAA Ambulance Company headquarters with a trained EMT on duty 24 hours a day to receive calls. He is capable of radio contact with all the ambulances throughout the AAA area and with the Highway Patrol and the hospitals. This is made possible by a radio net throughout the state of Mississippi, which again came about as a result of federal projects. Hospitals are regionalized in this system with regional hospitals able to communicate with all the hospitals in their region and also with regional hospitals throughout the state. 155-340 is used for regional interhospital activity and 155-280 is used for communications between central hospitals. The 155-340 is the working net for dispatching and hospital to ambulance communications of the District. The AAA dispatcher is also in contact with the Mississippi Highway Patrol, the Sheriff's office, and the local police.

C. Vehicles. The vehicles used within the system are those approved by the Department of Transportation for ambulances with proper size and shape and proper equipment being utilized entirely. Also, the air ambulance, as described, is utilized. This helicopter moves at approximately 100 to 110 M.P.H., flies 90% of the time, and is equipped with two liters in a tank. The helicopter is dispatched by means of a computer drawn map which determines the length of time of response from each of the areas which has a ground ambulance vs. the helicopter time from the base of operations.

D. EMT (Emergency Medical Technician). This man is the key to the entire system. His ability and training and enthusiasm and courage are the cornerstones on which any emergency medical system is built. We believe that with proper selection and proper training and continuing

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education, we have achieved a necessary goal in this system. Our EMT's are trained with the Dunlop course as prescribed by the Department of Transportation and all graduates take the National Registry examination for certification. Our principal instructor is on the payroll of the AAA Ambulance Company and is a Registered Nurse. The course is taught by her and by EMT's and by local physicians. The course is coordinated by a member of our Mississippi Trauma Committee of the American College of Surgeons. Our training program in the state is a cooperative effort by the Mississippi Trauma Committee, the Governor's Highway Safety Program, the State Board of Health, and the Department of Education through its Vocational Technical Division, and the Junior Colleges. Our statewide program has been functioning for some time now and the state of Mississippi has recently, this year, passed an EMS law which is excellent. It requires proper ambulances, the proper equipment, properly trained EMT's and licenses both ambulance companies and EMT's. The National Registry examination is that used for licensure. We have also recently passed legislation which allows not only the formation of Air Ambulance Districts and the taxation required therefor, but for any area to form an EMS District, and to levy taxes for the support of same.

In addition to the 81 hour Dunlop course, the EMT's receive Multi-Media standard first aid, standard and advanced first aid, both of which are prescribed by the American Red Cross. They also take a defensive driving course designed by the Mississippi Safety Council.

E. Hospital Emergency Department Care. The Forrest General Hospital in Hattiesburg is the regional hospital for our area. This hospital is fully staffed with on-call specialty physicians, full time emergency physicians, and equipment to administer emergency and definitive care in all areas except open heart surgery. The hospital contains an Intensive Care Unit for surgical and medical patients, a Coronary Care Unit, X-ray Department, Blood Bank, Laboratory, etc. as required for the care of the critical patients within the system. Rehabilitative care is also offered through a large Physical Therapy Department and post-hospital care capability enhanced through an active Social Service Department.

Throughout the evolution of this system both in the formative and implementation stages, we have attempted to create goals and methods of reaching them. Many of our goals have been met and a number of our goals are at the present time within our reach. This has been made possible by a \$451,000.00 grant by the Department of Health, Education, and Welfare for Emergency Medical Services in the Southeast Air Ambulance District. This project includes the purchase of proper ambulances with proper equipment, a central dispatching capability throughout the 7 county District, and mobile Coronary Care in a localized area. We are at present deeply involved in this grant and have, in March of 1975, awarded contracts for a spectacular central dispatching capability which involves a central one number notification telephone capability,* a modern dispatching console with ability to monitor all personnel and all equipment throughout the District, and instant communication

throughout the District with each hospital and each ambulance by the dispatcher. It includes the ability to monitor patients by way of EKG telemetry to the emergency room physician at the Forrest General Hospital with capability of communication by this physician with the EMT directly caring for the patient either in the ambulance or on the scene of the incident. It is within the scope of this project that the EKG and two-way voice talk are simultaneous. It is also within the capability of this system to bring in expert consultation with other physicians within the system. We are currently giving an advanced training program to our EMT's, which will give them the capacity to give I.V. drug and fluid administration and to treat heart attack victims. This capability will only be exercised under the direct order of a physician. These physicians are currently undergoing a Coronary Care course in order that they may render expert advice on all occasions. Dispatchers will be trained in a special course designed by the University of Southern Mississippi. Our system is to be further enhanced by a recent award from the Regional Medical Program of \$150,000.00 for remote Coronary Care monitoring to be carried on also at Forrest General Hospital under the auspices of and supervised by the physicians of the Coronary Care Committee at the Forrest General Hospital. This will allow constant monitoring throughout the system's hospitals of myocardial infarct victims by a single source and the expert advice of cardiologists to the attending physician at the scene. With this system it is possible for a person to have a heart attack 40 miles from Hattiesburg, to be ministered to by EMT's who transmit the cardiogram to the emergency room physician who gives the proper medical responses; for this patient to be transported under the care of this emergency room physician to the outlying hospital where he is moved to the Coronary Care Unit and the care is continued under the watchful eye of the remote monitoring system - continuous expert care from one central source from scene of heart attack through the entire prehospital and hospital phase of treatment.

We feel that we indeed have and are obtaining a unique capability in our system's area. This has not come about through the efforts of one, two or even twenty-five people or institutions. This has come about through the cooperation and dedication of literally hundreds of people. In order to better understand the cross section of capabilities and technology involved in our system the following is offered: (1) the medical staffs of the numerous hospitals in towns and cities within our District, physicians who are dedicated to the care of patients in need in an expeditious and expert manner to improve their chances of survival and to improve their life style following acute injury or illness; (2) the University of Southern Mississippi through its School of Science and Technology has contributed greatly. They are currently our computer arm and our evaluators. Much of the planning and thinking that has gone into our grant applications and much of the dreaming that we have done has been inspired by these people. Dr. William Brundage and his staff have worked tirelessly in our behalf. (3) The Mississippi State University through its School of Engineering has contributed Mr. Don Fitzgerald, Professor, as our Chief Communications Consultant and

Expert. His abilities and his willingness to work unceasingly have been the backbone of our communications system. (4) The numerous hospitals throughout the system and the administrators of these hospitals have been an integral and necessary part of all our projects. Each has risen to the task on each and every occasion with in-service training, with dispatching and ambulance capability and with organizational and administrative ability. (5) Elected city and county officials have cooperated and have been a necessary portion of our system. (6) Law enforcement officials, both city, county and state, are particularly necessary in the finding and notification phase of the EMS system. (7) The planning and development District personnel. (8) Radio personnel. (9) Radio, television, and newspaper people have been most instrumental in helping to generate the enthusiasm and the support necessary for the levying of tax and the paying of same which is vital to our District. Without the cooperation of this group, it is my feeling that our task would be next to impossible. (10) The Mississippi State Legislature has studied, argued about, and passed the proper legislation to make our District possible and to give proper thrust to Emergency Medical Services throughout our state. (11) On a state level the Emergency Medical Services Division of the State Health Department, the EMS Council for the State of Mississippi, the Governor's Highway Safety Program, the Department of Education through its Vocational Technical Division, the Comprehensive Health Planning Group, and the Mississippi Trauma Committee of the American College of Surgeons all have been active in our behalf. Last, but not least, the taxpayer has been the most instrumental factor in our system for he is, after all, the basis upon which we operate. The taxpayer and his representative's insight and recognition of emergency care as a necessary and imperative part of his health care is the cornerstone upon which together we have built and are building a proper Emergency Medical Care System.

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Technology Utilization Programs
At the NASA Lyndon B. Johnson Space Center

John L. Sigmon*

INTRODUCTION

During the last several years, the Life Sciences Directorate at the NASA Lyndon B. Johnson Space Center has been responsible for the health care and physiological monitoring of the astronauts during both training activities and manned space flights. This organization has also been responsible for the planning and development of the health care systems for future long-duration earth orbital and interplanetary missions.

Interplanetary missions would not permit an easy return to earth to care for medical emergencies. Space crews of the future will probably include a physician's assistant who, through communications with the ground based control center, will have access to ground based medical consultants as required.

Many similarities exist between quality health care systems for crews on long-duration space missions and systems for people in remote regions on earth. In isolated areas on earth as well as in spacecraft, the physician or other health care personnel usually administers health care in less than optimum conditions. However, if he has available to him communications with specialists, and limited clinical, surgical and therapeutic equipment, he can do a much better job. The data from an abnormal electrocardiogram obtained from an astronaut and communicated to the ground may closely resemble that from a patient in a remote location on earth. Today the EKG may be easily transmitted to a medical clinic several hundred miles away. Similarly a high-resolution video imaging system may be used to transmit an x-ray of a leg fracture of an astronaut or isolated patient for evaluation to an orthopedic surgeon several miles or several thousands of miles away.

STARPAHC

In 1971 the L. B. Johnson Space Center was asked by the President's Domestic Council to conduct a study program for an improved health care

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system. The published results of that study, "A Program for Expanded Health Services in the United States," recommended that NASA "undertake a joint program with the Department of Health, Education and Welfare for the improvement of health care service in a selected remote area." In addition to improving the selected health care delivery system on earth, the program would allow NASA to develop specific medical requirements for a health care system for future space missions.

The program would allow the determination of the probability of incidence of illnesses and injuries and the identification of personnel, procedures and equipment necessary to diagnose and treat them. Valuable information could be gathered for the future space missions concerning medical skills required of the onboard medical personnel, physician-astronaut, etc. The use of two-way voice and spacecraft to ground television communication links could be evaluated for handling serious medical emergencies.

As a result of the study, a cooperative effort between NASA and HEW was begun in 1973 and will continue through 1976. The program, called STARPAHC (Space Technology Applied to Rural Papago Advanced Health Care) has as its objectives:

To provide data for developing health care systems for future manned spaceflight through:

- ° Further development of the physician-paramedic concept
- ° Clinical evaluation of advanced bioinstrumentation
- ° Development of computer support for remote health care
- ° Integration of video viewing and display devices
- ° Definition of skills, training and procedural requirements
- ° Evaluation of existing techniques for space application
- ° Identification of technology advancement need areas
- ° Refinement of protocols and techniques

To improve the delivery of health care to remote areas on earth through:

- ° Improved communications methods
- ° Development of an advanced mobile health unit
- ° Advanced supportive health care equipment
- ° Application of computer aids developed for the space program

- ° Assistance to allied health professionals and health education programs

APPLICATIONS OF NASA TECHNOLOGY

Many of the procedures and equipment developed for the STARPAHC program may have application in other fields of health care delivery. An example of an application already in use is the Telecare system.

Telecare

A concept proposed in the study for the President's Domestic Council concerned portable health services equipment.

"The medical functions served by the Portable Health Services Equipment would be the augmentation of emergency equipment usually carried by ambulances, the provision of emergency equipment for vehicles (station wagons, helicopters) not ordinarily used for this purpose, and the extension of health services to bedridden patients by providing the trained physician's assistants or nurses with suitcase-sized equipment for making house calls."

A "Portable Ambulance Module" was described which

"should be a portable case containing combined cardiac monitoring, defibrillating and pacemaking equipment; respiratory resuscitating equipment; a supply of medical grade oxygen with regulator and mask; and aspirating equipment. The module would be self-contained and would be powered by rechargeable batteries. Supplies such as splints, dressings, and emergency drugs would be included."

In 1972 NASA identified items of Skylab medical equipment including a semi-automatic blood pressure measuring system developed for the Skylab program which could be combined in a portable ambulance module. Much of the circuitry and design concepts which were eventually incorporated into the portable ambulance module were direct applications of technology developed for the space program for ruggedness, compactness, and reliability. For a number of reasons, including commercialization potential, it was decided that NASA and SCI, Inc. would co-sponsor the development of the portable ambulance module.

Development of the first functional prototype of the Telecare system began in February 1973. By August 1973, when the unit was delivered to the L. B. Johnson Space Center, SJI and NASA had agreed to call the unit "Telecare." The delivered unit had the capabilities for:

- ° Simultaneous voice/EKG communications (telemetry and telephone coupled)

- Semi-automatic blood pressure measurement
- Oxygen supplies
- Aspirator
- Resuscitator and airways
- Laryngoscope
- Prepackaged drugs and supplies
- Stethoscope
- Defibrillator

The defibrillator developed by SCI is unique in that it weighs only 8 pounds. Obtaining this small size required a new circuitry design and resulted in delivering the electrical stimulus in a waveform different from that commonly used. This presented the problem of knowing whether the new defibrillator really worked. The Department of Medicine at Baylor College of Medicine agreed to test the system, and after several weeks of testing it appeared that this was one of the best defibrillators available.

The system measured 21 X 10 X 14 inches and weighed 42 pounds. Two additional units were purchased and are in use in the NASA STARPAHC program, a telemedicine project being conducted with HEW at the Papago Indian Reservation in southern Arizona.

Soon after the development of the Telecare system had begun, the City of Houston Fire Department became aware of the program. The Fire Department had recently assumed responsibility for providing emergency medical and ambulance services and was interested in improving the quality of their activities.

The Houston emergency medical service responds to 500 cardiac calls each month. Response time from the initial call to arrival of the ambulance at the scene averages 5.4 minutes. Average transit time from the initial call to arrival at the hospital emergency room is 21 minutes. Even with this rapid response capability, the average survival rate for heart attack victims was only slightly above the national average of one in ten. The heart attack victim only has approximately 3 to 5 minutes if his heart stops beating and the oxygen supply is cut off to the rest of his body until irreparable damage is done to his brain.

Local physicians and city officials thus undertook the task of further improving their emergency medical service. Many problems faced these individuals including funding, equipment, and training of physician's assistants (or Emergency Medical Technicians - EMTs).

The planners realized that life-saving medical care such as starting IVs, giving selected drugs, and performing cardiac defibrillation in the field could greatly increase the chances of a person surviving a heart attack. However, under Texas law, this emergency care must be administered on direct order of a physician. Thus any future program required advanced training and equipment, and elaborate communications including telemetry of biomedical data.

At the time, EMTs were hampered in their work by the bulky equipment they used. In each ambulance was a 30-pound defibrillator, a bulky communications suitcase, a drug kit, oxygen bottles, and an equipment suitcase. Members of the local medical society felt that a single suitcase was needed containing all the necessary emergency medical equipment. The planners also wanted a communications system with duplexing and multiplexing, thus allowing the EMT and the attending physician at the hospital emergency room to talk to each other simultaneously on different frequencies while also transmitting the victim's EKG.

Most major medical equipment manufacturers told the planners that such equipment was not possible. However, it came to Houston's attention that NASA was developing just such a system for the STARPAHC program in cooperation with SCI, Inc. of Houston. Since Houston's requirements differed in some areas from NASA's, NASA agreed to review their proposed system specifications.

The Telecare system has been in use in Houston since December 1973. The city now has 31 Telecare units, of which 23 are installed in ambulances. Houston officials expect to eventually save 40 percent of the cardiac victims and greatly improve the emergency care administered to trauma cases. In the year and a half that the Telecare system has been operational, Houston has already increased their cardiac patient survival rate to over three times the national average.

In July 1974 a newly formed corporation, Telecare, Inc., bought the interests to the Telecare system from SCI. Telecare, Inc. is now building Telecare units for Odessa, Victoria, and San Antonio, Texas, as well as Montgomery County, Maryland, and San Francisco.

This is just one example of how technology originally developed for the nation's space programs has been applied to man on earth. Some of the same aerospace people who were involved in the Skylab program, and the STARPAHC and Telecare projects, are now turning more of their attention to public application of space technology. One of the primary contacts for potential technology "users" is the Biomedical Applications Team and the Medical Applications Office at the L. B. Johnson Space Center. If a physician or a government administrator is aware of a health care problem which could be improved through the use of NASA technology, these organizations have the responsibility of assisting him in its application.

Note: The Biomedical Applications Team may be contacted at Mail Code DE6, L. B. Johnson Space Center, Houston, Texas 77058.

Other Biomedical Applications Teams may be contacted at Stanford Medical School, Research Triangle Institute, and the University of Wisconsin.

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TREATMENT AND TRAINING

Session Chairman: William Gill, M.B., Ch.B., F.R.C.S.

Australian Emergency Medical Care

J. Peter Bush

Clinical Experience with Emergency Medical Systems

Stanley M. Zydlo, Jr., M.D.

Emergency Medical Systems and Trauma Centers

Kenneth L. Mattox, M.D.

Emergency Medical Technician Training Programs

Reinald Leidekmeyer, M.D.

EMT/Paramedics and Emergency Medical Care

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AUSTRALIAN EMERGENCY MEDICAL CARE

J. Peter Bush

Australia is a vast continent, comparable in size to the United States of America and the vast majority of Europe. There are six independent States and the Australian Capital Territory which is administered by the Federal Government. It has a population of 13 million, 60% of whom are concentrated in five major cities, and 70% in the small south east corner of the continent.

HEALTH SERVICES

The Federal Government, situated in the capital city of Canberra, is responsible for primary medical services. Hospital services remain the responsibility of the State Governments.

Commonwealth - State relationships are not always harmonious, and differing political ideologies between the Federal and State Parliaments at times produce conflict.

Primarily, the health services operate on a private enterprise fee-per-service basis, supported by a system of private insurance to cover 90% or most of hospital and medical charges, provided hospitals and doctors do not exceed the "common fee" principle negotiated between the Government and the profession. The private insurance system is almost universal and only the very wealthy, indifferent, casual, or negligent and irresponsible fail to contract for such cover.

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Director of Emergency Department,
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The Federal Government subsidises the Insurance Funds on a 50 - 50 basis.

The Pensioner Medical Service provides Government funded payments to doctors and chemists (drug stores) for persons over the age of 65 male, 60 female, and permanently disabled, temporarily sick, widows, and deserted wives. This refund scheme has the defect of creating a two tier structure for patient care, private and pensioner, which is aggravated because the refund payment to doctors for a consultation under the Pensioner Medical Service is less than the accepted common fee payment in the private insurance scheme.

A further group of patients are catered for under the Repatriation Department Medical Service. This covers ex-service personnel in a privileged way at a rate between the Pensioner Medical Service and private fee structure.

The responsibility for the provision of emergency medical care is not clearly defined. Patients present with emergencies to private practitioners or to hospitals, the decision upon which to call frequently being made on geographical, or simply circumstantial grounds.

The percapita expenditure on Health, Hospitals and Charities by State are as follow, compared with Education and Law and Order:

	<u>Health</u>	<u>Education</u>	<u>Law & Order & Public</u> <u>Safety</u>
New South Wales	\$ 34.5	64.3	12.54
Victoria	29.25	69.5	10.43
Queensland	32.8	53	14.15
South Australia	29.35	65.8	11.48
West Australia	46.01	70.4	15.15
Tasmania	40.6	73.6	14.61
<u>TOTAL</u>	33.40	65.05	12.36

The Federal Government plans to introduce a universal health insurance plan, Medibank, later this year. This legislation is meeting considerable opposition from political and professional sources.

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Consideration of the health services necessitates a consideration of the differing needs of urban communities and isolated rural areas.

URBAN EMERGENCY SERVICES

Most emergencies are dealt with in urban areas by the major public hospitals. The majority of these in the capital cities are associated with Universities and teaching hospitals. However, despite this fact, there are still considerable areas where improvements can be made.

One particular area of improvement in the past few years has been the development of Mobile Intensive Care Ambulances. These vehicles were primarily designed as elsewhere in the world as Coronary Care ambulances to combat the high incidence of death following sudden collapse due to myocardial infarction. These vehicles have come to be used also for other conditions, and although their full utilization is far from complete, they have already proved their value. The current year coincides with a major program of public education in the Value of C.P.R. and the early call for assistance following heart attack.

Casualty Departments, Accident Departments, or Emergency Departments; whatever name is used, have in many instances grown up gradually and the facilities they provide have been outstripped by the demands made upon them. In my own department, the patient load has increased at a steady rate of 6% per annum for several years.

These Departments in major hospitals are providing for three separate streams of patients -

- i - the acute emergency including trauma, collapses and severe illnesses,
- ii - the general practitioner or primary care, and
- iii - those requiring specialist consultant opinion available in large teaching hospitals.

In many hospitals still, the facilities for these different types of patients are not separated. The improved standards of modern emergency care demand an efficient separation of the varied types of patients using Emergency Departments. It is now unreal to expect adequate specialist care in the medical supermarket atmosphere which still pertains in many hospital Emergency Departments.

Some hospitals, and particularly in Western Australia, have made provision for patients requiring primary care to be seen by experienced general practitioners employed on a sessional basis. This group of patients has a separate entrance from the emergencies, and they are seen in a separate area.

In the Royal Melbourne Hospital, we have managed with some renovations to provide some streaming of the patients and to divide the Department into two main areas with a separate Emergency Resuscitation Bay.

The key to the efficiency of this streaming is the development of a system of Triage. Every patient on arrival, and after clerical documentation and registration, is seen by a trained nursing sister whose responsibility is twofold:

- 1) To determine the degree of urgency of each patient's condition, and
- 2) To allocate the patient to the area of the Department appropriate to his condition and degree of urgency.

Patients with acute emergencies, collapse, severe trauma, are not delayed by clerical procedures and when prior warning of their arrival has been given, are immediately conveyed to the Resuscitation area.

ROAD TRAFFIC CRASHES

As in so many other countries, road traffic crashes produce a disproportionate amount of death and injury. Special measures have been employed successfully in some States to cope with this problem, and there are a small number of isolated schemes set up for the management and treatment of road crash victims. Alcohol and speed, and particularly the inevitable combination of these two factors contribute towards a very high proportion of the road traffic injuries. Victoria has been foremost in legislation which has produced a downturn in the statistics of road deaths and injuries. The introduction of the breathalyser with a maximum permitted level of .05 mgms. alcohol per ml. blood; compulsory wearing of seat belts and motor cycle head helmets; an overall speed limit of 60 m.p.h. (100 km./hr.) and more recently the compulsory blood testing for alcohol of all Road Traffic Accident victims requiring hospital treatment, have been contributory factors to this improved situation.

Apart from these measures, the post crash management of the victims has been improved. Hospital Emergency Departments have been up-dated, and in certain areas, groups of individuals with or without Government support have attempted to provide better facilities for on-site care of the road crash victims.

Groups of doctors in Western Australia, Victoria and South Australia have established a voluntary system of on-call roster for road crashes. These schemes have operated in conjunction with the local Ambulance Services. In New South Wales one lone practitioner has provided a service in an isolated area where a major highway penetrates his own rural practice area.

EMERGENCY CARE IN RURAL AREAS

In many parts of Australia distances are so vast and the population so sparse that the provision of emergency medical services creates great problems. This is to a considerable extent overcome by the Royal Flying Doctor Service which provides medical and nursing advice and physical assistance if necessary. There are at present no established programs of medical or first aid education for these areas, but these are being developed by Government and voluntary agencies.

THE ROYAL FLYING DOCTOR SERVICE

A non-sectarian organization- The Royal Flying Doctor Service comprises thirteen bases from which its air-borne doctors serve the inhabitants of two-thirds of the continent and Tasmania. Its 21 aircraft fly in excess of 1½ million miles each year bringing medical attention to upwards of 50,000 patients, of whom 4,000 or so are transported to hospital.

Urgent flights should not need elaboration to establish their value. Bush people suffer from fractures, acute appendicitis and other illnesses, just as city folk do. The combination of wireless communications and fast, comfortable transport by air saves lives and limbs.

But emergency flights are only part of the story. The Royal Flying Doctor Service aims at providing a full range of medical services over the whole of its vast area of operations.

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Routine visits (at least monthly) are made to isolated communities. Some of these have small hospitals for which resident medical officers cannot be obtained. The Royal Flying Doctor Service is supervising many such hospitals at distances of up to 400 miles. Having a ready means of communication with the matron, one can admit, treat, and discharge many patients, making a final check on them at the next routine visit. Others of these communities have no local medical service of any kind. All the ordinary activities of general medical practice are undertaken, including antenatal supervision, immunisation, etc. Sufferers from chronic illnesses, such as diabetes and pernicious anaemia, can be regularly checked and their treatment modified, so that they are enabled to go on living and working in remote localities, whereas otherwise they would have to move in to more closely settled areas, involving hardship to the patient and accentuating the drift from the bush. People commonly come in as much as 50 miles, and often further to these clinics. Their nearest resident doctor may be anything up to 300 miles away. When people are faced with a round trip of 400 to 600 miles to see the doctor, it is little wonder that antenatal supervision and immunisation go by the board, and the chances of serious illness coming to early diagnosis are gravely reduced.

Advice by radio is given in hundreds of cases in which the illness is not serious enough to warrant a flight. Mothers can be advised regarding their problems in infant feeding and the treatment of minor ailments. According to their ability, relatives can be assisted to care for patients with fairly acute illnesses in their own homes. To facilitate this treatment, the Flying Doctor Service manufactures a standard medicine chest; hundreds of these chests are kept at station homesteads, police stations, mission stations, lighthouses, etc.

Each Royal Flying Doctor Service Section is a non-profit, non-denominational organization, incorporated in its own State of the Commonwealth, and is autonomous in the administration of its own affairs.

Sections have as their common objective the aim of fostering, developing, and safeguarding the health of the people in sparsely settled areas, promoting and assisting and conducting research in medical aviation, radio and the physical well being of the people in such areas. Medical assistance is given to mission and philanthropic societies catering for the physical well being of aborigines.

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The annual cost of operations is now in excess of one and a half million dollars which comes partly from Federal and State Government grants, but mainly from voluntary donations by the people whom it serves, their city friends and by charitable bequests.

DISASTERS

Natural or man-made disasters occur frequently with little or no warning. Adequate preparation and awareness of the potential problems thus created is therefore essential if the disaster is not to be compounded by chaotic relief services.

Australian disaster organizations at Commonwealth and State levels are being reviewed and strengthened by the formation of a National Disaster Organization. The agencies involved are both statutory and voluntary. It is necessary for all services involved to have a close working relationship and accurate knowledge of each other's capabilities and resources.

Within Australia the State Disaster services co-operate with the National Disaster Organization. Voluntary Organizations, Red Cross, St. John Ambulance Brigade, Country Fire Authority and others also have a role to play.

Natural disasters are fortunately rare, but the recent typhoon destruction of Darwin is a grim reminder of their potential. A full report on the medical aspects of this disaster is not yet available, but it is hoped that some details will be presented at the Conference.

PUBLIC EVENTS

Major public occasions, processions, carnivals and sporting events require good medical and first aid cover. These are provided mainly by voluntary agencies; Red Cross and St. John Ambulance Brigade. Personnel of these organizations are laymen trained in first aid who give their services voluntarily. The amount of time thus freely spent is enormous.

In recent years with the increase in more sophisticated resuscitation measures, well-equipped teams are provided for major sporting events.

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At the Football final matches in Melbourne, with a capacity crowd of 120,000, two Resuscitation teams are on duty. These comprise a doctor, trained nurse, radio operator & two stretcher bearers. In addition to these teams, 120 - 150 first aid personnel are on duty at these matches.

For the past four years a major Pop Festival attracting up to 40,000 people has been held outside Melbourne. Full medical and first aid cover has been supplied by the St. John Ambulance Brigade. This has involved 10 - 12 doctors, 15 - 25 nurses and 120 - 150 men, women and cadets at each festival.

THE ST. JOHN AMBULANCE BRIGADE: uniformed

The St. John Ambulance Brigade in its black and white uniform is familiar throughout the Commonwealth. It is made up of Medical Practitioners, State Registered Nurses, trained First Aiders and auxiliary Nurses, numbering over 14,500 volunteers. All are trained, equipped and clothed at their own expense.

The grass roots of the Brigade are the 115 Adult and Cadet Divisions in Victoria, each placed where it can best meet the needs of the public.

The members give thousands of hours' voluntary service each year over a wide field of activities: First Aid wherever crowds collect and casualties can be expected.

They supplement the public services with their own mobile posts and Rescue Vehicles; provide speedily mobilised groups in bush fires, times of disaster - rail crashes, floods and hurricanes - assist State Police in searches and other activities, e.g. Pop Festivals.

St. John Cadets (boys and girls from 11 - 16 years) learn preliminary First Aid and Nursing and assist adult members in certain Brigade duties. In addition Cadets can gain proficiency in a variety of subjects - swimming, clerical work, child care, camping; and when they have qualified in twelve subjects they win the Grand Prior's Badge - the highest award for proficiency.

Today the Brigade in this State has equipped itself by self effort with the following equipment:

VEHICLES - 2 WAY RADIO (H.F. and U.H.F.)

4 H.Q. Field Control	4 Mobile Nursing
1 H.Q. Radio Base	4 Medical Caravans
52 Light Rescue Vans	1 Mini Trail Motor Cycle
10 Heavy Rescue Vans	TOTAL 76

EQUIPMENT AVAILABLE

Power Generators	U.H.F. Portable Radios
Flood Lights	Portable Loud Hailers
Powerful Searchlights	Oxygen Resuscitation Kits
Hydraulic Lifting Sets	Oxy-Acetylene Cutting Gear
Underwater Diving Gear	Surgeons Emergency Medical Kits
Normal-Air Breathing Sets	First Aid Supplies for 2,000 Casualties
Cliff Rescue Gear	
Metal Cutting Power Saws	

THE ST. JOHN AMBULANCE ASSOCIATION: non-uniformed

The St. John Ambulance Association teaches First Aid, and examines and issues certificates. In any average year about 10,000 First Aid Certificates are awarded to people in all walks of life, from industries to remote towns, who have taken a course of First Aid training and are now qualified First Aiders.

The qualification has many uses:

- + It gives a man another skill.
- + It equips him to aid his family, his friends, the public, and occasionally even himself in cases of injury and sudden illness.
- + It teaches self-reliance and safety consciousness.
- + It provides knowledge for Youth Leaders engaged in adventure activities.
- + It is invaluable for teachers and anyone in charge of young folk.

CLINICAL EXPERIENCE WITH
EMERGENCY MEDICAL SYSTEMS

Stanley M. Zydlo, Jr., M.D.

During the past five and one-half years I have been deeply involved in a new, developing, existing and rewarding area of health care delivery in Emergency Medical Services.

I initially became involved when I personally viewed poor and inadequate care being rendered to victims of illness or injury, whether they were being cared for at the scene of the injury or illness or inside the walls of a hospital.

The personal experiences of poor emergency care, augmented by ideas for improved care from other individuals, rapidly directed me to the area of E.M.S.

Emergency care then was new, largely uncharted, and a definite challenge wherein I visualized the possibility of being able to accomplish a meaningful change in a neglected area of patient care.

I soon realized how broad the area of E.M.S. was and also, how complacent and naive our whole country was in its

Chief of Emergency Services
Medical Director M.I.C.U. System

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attitude toward emergency care.

Four or five years ago most people believed that if they were ill or injured a highly qualified ambulance crew would zoom up to the rescue, render efficient, effective proper care and speed the victim to the Mecca of life saving - the hospital.

Investigation led me to realize how poor our entire emergency care delivery system really was nationally. I felt that in my lifetime, about my given plot of earth I would do my best to bring about change, for it simply should be done.

Patients waited four and one-half to six hours to be cared for in an emergency department. Ambulance service by and large was poor in effective function and capabilities of crewmembers. The highway trauma death rate was escalating yearly to exceed in numbers killed, more that we could kill in active warfare in a five year period. Prehospital deaths from heart attack and shock were common; the death rate for heart attacks being in the neighborhood of 60% of those stricken. Organized medicine could only respond with "Tsk, tsk, sorry, but we did all we could"! Yet, the public was being brainwashed with T.V. and magazine propaganda about how great our medical capabilities were, and how advanced our communication and transportation skills are.

A realization suddenly occurred to a few in this country

that maybe something could be done to resume life and vital function. If advanced skills and techniques could be applied to those needing vital aid at the place and time it was most important, we could probably decrease the mortality for many life threatening problems. Physicians and nurses just couldn't be everywhere, and this meant that new personnel were needed to bring about change. We needed people whose primary function was to be able to perform life saving skills while under stress and at the time and place where the victim most needed those skills.

The Emergency Medical Technician (E.M.T.) and E.M.T. Paramedic were the logical answers. These people were needed to bring about a drastic change in pre-hospital emergency care delivery. Their development has triggered several significant changes in the entire health care scene.

First of all, EMT and EMT Paramedic training and function has helped to break down the mystique and magic of medicine. They are people other than M.D.'s and R.N.'s who can learn concepts of the recognition and treatment of serious illness and injuries and who are capable of performing life saving skills previously reserved strictly to those in organized medicine. Application of this knowledge and skills when the victim needs them most is helping to prevent loss of life or vital function by those in need.

Attention directly at improved initial care by non-

medical professionals has stimulated an interest among M.D.'s and R.N.'s. It seems that a spark has ignited in many in the medical profession to inflame the desire, drive and motivation for personal upgrading, continual education and improved function. I may best express this by citing a statement of a physician friend who once declared, "Hey, if these ambulance attendants can learn and know all that stuff about cardiac cases, I'd better learn about it". This view has also been expressed by nursing personnel and new specific roles in the medical and nursing professions are developing, the Emergency Physician and the Emergency Department Nurse Specialist.

Development and recognition of these new roles sadly occurred initially, not by the wisdom and intellect of the medical profession or our educational system, but rather by public recognition of inadequate emergency care and its resultant demand for improvement.

Our medical and nursing educational systems did not then and by and large, do not now have functional hands-on-skill programs specifically in life saving emergency procedures as part of the basic curriculum for the medical or nursing student. It is as if it was "assumptive learning". I mean, that in most schools, it was assumed that we would learn how to deal with emergency problems somewhere along with all the rest of the medical knowledge we were to receive.

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Education and re-education of M.D.'s and R.N.'s involved in the care of the critically ill or injured was necessary for it soon became clear that simply training ambulance personnel to a high degree of function would not itself bring about significant improvement in emergency care. A true team concept has crystallized in successful functioning E.M.S. systems and all members share equal importance in bringing about better patient salvage rates. This combined team of a physician, nurse and EMT or EMT Paramedic has served yet another very important role, and that is; it has given to the public, a long sought after image of medically oriented people who care and are interested in the ill or injured outside of the hospital. This community medical action role is a potent tool for bridging the heretofore wide gap of understanding and trust between the medical profession and the public.

In the past three years interest in E.M.S. systems has rocketed and emergency care has been publicized and spotlighted in magazines, on T.V. and most medical oriented meetings. Exposés of poor emergency care delivery have led to reorganization of the delivery of that care in many areas. New ambulance design and capabilities are evident everywhere and future designs are on the drawing boards.

Consumer demands for better more efficient and

effective care has forced providers of poor care out of business in some areas and the same demands have caused improved emergency care facilities to be designed and built.

Though changes are occurring, it is still sad to realize that nationwide, we still have a far way to go. In a recent survey it was stated that only an estimated 22% of all ambulances in the country have two-way radio-communications to a receiving hospital. Further, that even if the ambulance had the communications capabilities, who would they talk to? In over half the country's hospitals there is no physician present in the emergency department, and there may not even be a nurse on duty in that area except on an on-call basis.

Do E.M.S. Systems really work? How do we measure their effectiveness? Unfortunately, I don't believe anyone has the perfect answer yet. Many wish to measure the success of a particular system on the basis of how many dollars it costs per life saved by a successful resuscitation. Resuscitating someone who is clinically dead is dramatic and certainly of value, but how can we put a dollar value on the many who, due to proper on-scene care, we prevented from dying in the first place? We can't tell who will fibrillate of all those who get a heart attack, but we do know that more than half die before they get to a hospital where no good systems exist. In our particular area a recent survey revealed

that over 84.6% of patients with a heart attack arrived at a hospital alive - a far cry from the national figures where only 40 - 50% arrived at a hospital alive. On, how can we measure the prevention of death or disability of the thousands who are involved in auto accidents yearly and are properly treated at the scene? Studies revealed that in some areas up to 22% of those who die in auto accidents had injuries which, if initial good care were given, should not have killed the victim. How do we measure these people who we prevent from dying by proper prompt care? Can one really put a dollar figure on these cases, or on the many who survive from other critical medical problems due to good initial care?

If we had a means of calculating the "prevent-saves", those who we prevent from dying and therefore "save" from death, we would have an excellent tool for the dollars/life oriented minds. We have no such measure except by statistical data changes and those figures can be too easily altered.

The apparent success in delivery of emergency care has propagated a wave of interest, but also has brought along its share of problems.

Huge sums of money are being granted for development of E.M.S. Systems. Unfortunately, grants seem to be going to those who need it least financially but who do have excellent grant writers. Others who need financial

assistance to initiate programs are left wanting for lack of the grantsmanship capability. Also, unfortunately, most of the grant funds are utilized in administrative paperwork and the amount of funds that actually are put to use to develop a system are small.

Those systems that are successful seem to be ones who developed by their own initiative and resources, thereby having a built in means of sustaining themselves and avoiding excesses.

The success of E.M.S. Systems can be measured by the increased involvement and awareness of physicians, nurses, hospital administrators and ambulance personnel in those areas where such a system exists when compared to an area where no E.M.S. system is present. Doing things the same "good old way" is still prevalent in most parts of this country - and it is perfectly acceptable to those who don't wish to be involved or have gun barrel vision.

The development of E.M.S. and its component members appears to be on firm ground and in a definite direction with delineation of training and specificity of the Emergency physician and Emergency Department Nurse Specialist. The length, duration and direction of the E.M.T. Paramedic is still being jostled about; however, with institutional and organizational egomania at the helm. Through the ralling storm of its journey one

thing seems to be clear, we need more physician involvement in training of E.M.T.'s and E.M.T. Paramedics. We need more physician and nurse education and input into EMS systems to save us from those planners who are sold on the erroneous concept that mechanical gadgets and highly sophisticated communications gear will be the answer to a communities E.M.S. needs. People to people contact, trust, cooperative desires and side by side function are the real gut level components of any successful E.M.S. System.

EMERGENCY MEDICAL SYSTEMS AND TRAUMA CENTERS

Kenneth L. Mattox, M.D.*

An analysis of the care of the unfortunate victim of an accident may be approached from a historic viewpoint, from an expose of existing nonstandard health care delivery schemes, or from the standpoint of practical, applied idealism. Although by pure numbers, neoplasia and atherosclerosis contribute to population control by death, an actuarial analysis reveals that TRAUMA is the leading cause of death and disability for all age groups. That is to say, if one multiplies a patient's age by the number of functioning years left to this patient after an illness intervention and lists in ranking order the products, trauma heads the list.

This analysis of trauma centers, therefore, will consider extension of the present state of the art as being the goal. With this assumption, delivering emergency medical service systems will not require rediscovery of the trauma care treatment wheel, which would be both painful and expensive. By an analysis of historical lessons, one may prevent repeating problem areas made by early trauma center concepts.

An emergency medical service system may be defined simply as containing components of engineering design, prehospital care, definitive hospital care, and rehabilitation. Emergency medical services become a continuum that begins before an illness or injury occurs with engineering design of a highway, a regional hospital system, or safety designs on an automobile, and does not cease until the consumer has been returned as a functioning member of society.

Trauma, on the other hand, is one specific phase of emergency medical care. Simply defined as accidental death and disability, trauma includes the victims of automobile accidents, drownings, industrial mishaps, plane crashes, gunshot wounds, stab wounds, burns, household accidents, attempted suicides, minor injuries secondary to social altercations, and many others. As a geographic phase of the

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in-hospital portion of the emergency medical service system, trauma centers are designed to reduce death and disability among those accident victims.

HISTORY OF THE MANAGEMENT OF THE TRAUMA PATIENT

The Edmund Smith Papyrus, the oldest written surgical text, contains several case studies of victims of trauma, lists treatment modes, and outlines prognoses among selected injuries (1). With each war, contributions have been made in the care of the trauma victim, be it in treatment of specific injuries, transportation of war victims, understanding fluid and electrolytes, development of transfusion therapy, application of antibiotics and anesthesia, or development of concepts of categories of treatment facilities at specifically pre-assigned areas to respond to given needs. With these advancements, there has been progressive reduction in the mortality of war injured victims (2). It was from the success of the battalion aid station in the 1940's during the Second World War that the concept of the accident room emerged. This accident room ultimately became an emergency room, later an emergency department, and subsequently a comprehensive emergency center. Portions of these comprehensive emergency centers serve in larger cities as the trauma unit (3). In other areas a specific trauma unit divorced from the press of general medical illnesses and acute cardiac problems has been devised (4).

From attention gained through the efforts of multiple professional organizations and the impetus of a study by the National Academy of Science National Research Foundation, the facts concerning trauma are well known (5). Each year more than 55 million people sustain injuries, and 11.5 million people require bed care for one day or more, occupying more than 65,000 beds for more than 22 million bed days under the care of more than 88,000 members of hospital personnel (6). This results in the equivalent of 130 hospitals, 500 beds each, at full occupancy full time. Forty million injured victims required one or more visits to an emergency facility or to a physician's office.

Before the turn of the century when there were only three cars in the United States, two of them managed to collide in St. Louis, Missouri. More Americans have died from automobile accidents since the automobile was introduced into the American scene than have died from all the wars fought by this nation, including the American Revolution. The figures are over 2 million deaths from automobile accidents compared to slightly more than 1.5 million deaths from wars. Each year more than 400,000 persons sustain permanent injuries and over 114,000 die. During 1973, the cost of accidents in the United States was a staggering 41.5 billion dollars. In Texas alone, just before the energy crisis, an average of ten people per day died on the highways. Although there was an initial 30 percent reduction in highway fatalities with the lowered speed limits and decreased traffic, there has been a gradual return to pre-crisis statistics as people return to the faster life. The fact that over 50 percent of all automobile accidents have alcohol as the direct etiology adds to the tragedy (7).

ASSUMPTIONS AND QUESTIONS

In analyzing trauma centers, several assumptions must be made and numerous questions asked. The trauma center developed for a metropolitan area with extensive medical facilities and in association with a university and medical school may not have the same facilities, scope, staff or results as that provided in the emergency room of a 20 bed hospital in a community of 1500 people. In a community with only two physicians and one small hospital, concepts of categorization and of specialty care become a moot point. In these limited areas, the two family physicians must serve as cardiologist, surgical consultant, emergency physician, rheumatologist, pediatrician, and at times, pathologist. Regardless of his title, these physicians must serve as initial triage officers and, in truth, are primary care physicians.

It should be assumed that most medical schools will have a university hospital, or be affiliated with a city-county hospital in which the medical school staff and resident house staff provide coverage in an emergency department or de facto trauma center. A community hospital more than 20-30 minutes from the university hospital may serve as a secondary trauma unit or provide resuscitative skills with transfer to a regional trauma center by prior arrangement. A rural hospital may provide sophisticated care of the trauma patient either through trained staff, teleconsultation, or helicopter evacuation. Prototypes for these concepts have been developed in several states, including Illinois and Maryland.

Although prior to 1940 much emergency care was delivered by house calls, it must be assumed that the standard of care now requires the consumer (patient) to come to the emergency facility for treatment. Emergency facilities, then, may be inundated with persons who do not have urgent or life-threatening problems. It has been predicted that emergency department census in American hospitals will continue to increase at a rate of 5-6 percent each year (8). In the development of a trauma unit, several questions must be asked: 1) What configuration will the trauma unit have? 2) Will the trauma unit be separated from the emergency department of the hospital or integrated into the remainder of the emergency medical services? 3) Who will provide the staffing of a trauma center? 4) Should the staffing of the community hospital be equal to the staffing in a major medical school affiliated hospital? 5) Should the staffing in a rural hospital be identical to that in a community hospital? 6) How many trauma centers should a region have? 7) Is development of a trauma center at a given hospital the responsibility of a regional governmental agency, a council of hospital administrators, the county medical society, or self proclamation by an individual hospital? 8) What minimum standards are required for staff, equipment, and hospital back-up for an emergency department to call itself a trauma unit? 9) Does the trauma center contain plans for an area disaster? 10) Is there coordination between the regional ambulance and communication systems? 11) What financial structure exists to assure continuance of the trauma center?

DEVELOPMENT OF SYSTEMS

Development of a functioning trauma unit is dependent upon public awareness and demand. A trauma center must have public access with an integrated communication system with alerting capability from ambulance to hospital, as well as between hospitals. With advanced ambulance models, trained emergency medical technicians, early resuscitation and aggressive surgical management, patients with complex traumatic problems which in former years would have resulted in death are now being salvaged (9,10). A trauma unit, of necessity, must include in-hospital support for stabilization initially achieved in the trauma center. This continuum includes fully staffed operating room, blood availability, and laboratory and x-ray facilities, all with staff supervision and support.

As demonstrated in Illinois, regionalization by area designation of specific hospitals as trauma units has resulted in improved patient care and salvage of lives, with public and professional acceptance (11). Smaller hospitals within the region which are not designated as trauma units have not been required to close, and endorse the system. The Illinois system serves as a model to demonstrate a hierarchical transfer of those patients needing more specialized care to central trauma units on a regional basis. All systems require pre-planning and cooperation among hospital administrators, regional councils of government, and medical staffs. The pre-plan for a regional system must pre-date the purchase of expensive hardware and complicated transportation modes.

PERSONNEL

Prototype trauma centers which provide state of the art resuscitation and injury reversal are located in many major cities and associated with medical schools. Most of these centers maintain a comprehensive emergency center with a trauma unit as a section of the existing department. In general, the surgical staff with assistance from surgical residents and surgical subspecialties, supervise the trauma unit and provide the continuum from initial patient care to the time of full rehabilitation. Ancillary personnel, including trained trauma nurses, radiology technologists, nursing assistants, and laboratory personnel, are the corps trauma team. Clerical personnel, social service, hospital security, chaplain service, administrative management, management systems, biomedical engineers, and others contribute directly and indirectly to the trauma unit.

In sub-regions without a comprehensive emergency center, not associated with a medical center and where transportation to a comprehensive medical center is not feasible, community hospitals may develop trauma units. Although a surgeon may serve as a trauma team leader continuing the patient's care on through the operating room, lack of available surgical personnel precludes their use in every emergency department. In these instances, a primary care physician with training in care of the trauma patient, be it through family practice residency, primary care residency, trauma fellowship following a traditional specialty training program, or through a specific emergency medicine training program, provides the first line of defense in resuscitation

and stabilization. Should a community hospital designate itself as a trauma unit, the personnel providing this service should have received appropriate standard training to provide acceptable care to the trauma victim regardless of the postgraduate training arena. Guidelines developed by the University Association for Emergency Medical Services for the design of an emergency department provide recommendations for the development of such a unit (12).

TECHNIQUES

Internal operations vary, depending on the hospital and region. In certain areas where there is medical staff support, extremely aggressive maneuvers such as thoracotomy and the use of portable cardiopulmonary pump bypass in the emergency department provide extension of the art of trauma care (13,14). Techniques such as peritoneal lavage, percutaneous subclavian vein catheterization, rapid early nasotracheal or orotracheal intubation, flush and selective arteriography, burn debridement, and skill in suturing lacerations, as well as an understanding of neurosurgical and orthopedic injuries are areas of expertise usually required. The logistics of a trauma unit require strict supervision and rigid guidelines to avoid missed injuries and provide continuing education. Adjunctive maneuvers, such as overhead x-ray in the shock room, sterile packs autoclaved in the emergency center, x-ray and laboratory processing for emergency cases only, emergency nursing staff as a separate nursing unit, and clearly defined responsibilities allow for more orderly care of the trauma patient.

EXTENDING THE ART

It has been demonstrated in several states that advanced systems of communication, cooperation and transportation have resulted in superb salvage rates. Regional teleconsultation by use of closed circuit television, cable television and transmission of radiographs to a regional center might allow for more advanced care of a trauma victim in a rural area through recommendations by specialists within a regional trauma institute. A national central toll-free telephone line might provide postgraduate education for physicians on subjects relative to trauma, and, secondarily, for patients desiring specific information.

The development of the American Trauma Society is both timely and useful, as this health service organization promises to provide public education, public service and research for the trauma victim just as the American Cancer Society and American Heart Association have done (15). The application of techniques developed for cardiovascular surgery and other surgical specialty areas promises to extend the knowledge of hypothermia and blood coagulability to the trauma areas.

Finally, innovations in funding resources might better budget health care dollars which are available to a region for the care of patients within that region who become victims of accidental injury and disability. Within an urban region certain emergency rooms may find logistic and financial advantage to reclassifying their facility into a 24-hour ambulatory health clinic. Other major emergency departments may find local medical societies and councils of government designating

them trauma centers. It seems appropriate for physician chiefs of staff and administrators of area hospitals to meet, "bury the hatchet," and outline an area system of trauma care.

SUMMARY

The answer to the questions concerning the development of a trauma center must be discerned on a regional basis, depending upon regional need and epidemiology. With application of known technology and presently available surgical expertise, the trauma victim may expect better chances for survival in the years ahead. Further research into the prevention of fatal injuries is a function of a regional trauma center with national organizations, such as the American Trauma Society, with their local units to provide guidelines and public education.

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EMERGENCY MEDICAL TECHNICIAN TRAINING PROGRAMS

R. Leidelmeyer, M. D.

The concept that Emergency Care starts at the pickup point -- or actually one little step earlier, at the moment a potential patient or witness to an accident picks up the phone to call the Rescue Squad -- was not born overnight. Yet never before in the history of medicine has so much been accomplished in bringing literally life-saving medical care to a patient's doorstep, or home, or place of accident, in such a short time. What makes it even more remarkable and unique is the fact that we have come this far in a fairly short period of time, through the combined efforts and participation of individual and organized physicians, nurses, paramedical personnel and a variety of local, state and Federal government agencies. And it may be good for those of us (and I am one of them) who occasionally get frustrated at the slow pace and the endless debates during the innumerable committee meetings at whatever level, to step back every once in a while and realize the exciting fact that all those diverse groups and interests are getting together and have accomplished so much in this relatively short time -- and be proud that we have been a part of it all.

As I see it, two factors have given the main impetus to this development and its results: number one, the enormous influx of patients into this nation's Emergency Departments; and number two, the advance of cardio-pulmonary resuscitation techniques, which made us realize

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that lives could be saved by properly trained non-medical personnel. We who have been in this business since the early Sixties can still remember the early conferences on Emergency Care in which the main topics were always (1) the techniques of cardio-pulmonary resuscitation in or outside the Emergency Department, and (2) the insufficiencies and shortcomings of the entire rescue system in the field, meaning outside and up to the door of the Emergency Department.

I won't go into the reasons for the astronomical increase in the patient loads of the Emergency Department, but the result was that a number of us realized the inadequacies in medical education as far as delivery of Emergency Care was concerned. In August, 1968, a group of physicians in Michigan got together and started a local organization for Emergency Physicians; and in November, 1968, I organized the first national meeting of Emergency Physicians, attended by about forty people from about twenty different states, and the American College of Emergency Physicians became a truly national organization. We are now an organization with well over 5,000 members, recognized by the AMA and well on our way to becoming a separate specialty. One has only to look at the great number of meetings and conferences on Emergency Care -- one of our recent scientific assemblies had an attendance of over 2,700 people -- to realize that Emergency Medicine is the thing where it's at, as they say. The Emergency Department Nurses have organized, and their organization approaches 10,000 members after just a few years. Thus, it seems that things inside the hospital are moving very well and rapidly, which brings us to what is happening outside our Department. In 1966 Congress passed the Highway Safety Act, which called for the formation of the National Highway Safety Administration within the Department of Transportation. This agency sponsored nationwide studies of ambulance services, initiated guidelines for developing state emergency medical systems, and formulated an Emergency Medical Technician training program now used in most of the states. To improve and standardize EMT training, it recommended the formation of a national accreditation agency. As I said before, it was the realization of inadequacies and shortcomings in our education that made us, as

physicians, band together and organize ourselves, in order to improve the quality of the type of medicine we practice. The same applies to our nurses. But Emergency Care goes beyond that. It starts at the pickup point or even earlier. The delivery of Emergency Care outside the doors of the Department included a total hodgepodge of volunteers, firemen, paid or unpaid, funeral homes, private organizations and whatever else there was. Even up to this day, the cliché that a barber needs 1,500 hours of training in order to cut a man's hair, by law, and a man who is in charge of a human life does not need any training at all, by law, still applies basically.

Yet I think we have reached the point that we and all others involved in the actual delivery of Emergency Care have come to realize that each of us is a part of the team, no matter where one fits in, and that all members of that team should be regarded as and should be trained professionals. As a profession "comes of age", certain demands are made on it by society in return for a measure of public respect, esteem and trust. Among the expectations are that a profession be willing and able to set performance standards for its members and that it institute some method or way of designating those individuals who measure up to such norms. And this concept applies in the broadest sense of the word to all of us involved in Emergency Care.

Thus, in 1970 the National Registry of Emergency Medical Technicians was organized for the purpose of setting standards to promote the improved delivery of medical services. It created the concept of the Emergency Medical Technician and it set standards and requirements to become an Emergency Medical Technician. In order to become a basic EMT, in addition to such requirements as being 18 years of age, having a high school education or its equivalent, and curiously enough, being able to lift and carry up to 100 pounds, an individual has to complete a basic training course of 81 hours of instruction and practice as outlined in the following three accepted texts: "Emergency

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Care and Transportation of Sick and Injured", authored by the American Academy of Orthopedic Surgeons; "Emergency Victim Care", authored by the Ohio Division of Vocational Education; and "Emergency Care", published by the Robert J. Brady Company, Washington, D. C. After the 81-hour course, which is now taught in many community colleges and also by individual physicians, the candidate must take and pass a national examination consisting of a written examination of about 150 multiple-choice questions and a practical examination in which the candidate must demonstrate his ability to apply skills required of the EMT. He will then become a registered EMT-Ambulance with the National Registry. The Board of Directors of the National Registry consists of representatives of the different ambulance associations in existence in the United States, plus four elected physician Board members and a number of physician-consultants. The address of the Registry is 1595 East Dublin-Granville Road, P. O. Box 29233, Columbus, Ohio, 43229, and its Executive Director is Mr. Rocco V. Morando.

It is possible for those who are already rescue workers and ambulance drivers to become officially registered as EMT-Ambulance by completing at least six months of emergency ambulance or rescue service within twelve months prior to the date of application. Many states nowadays (in my opinion, unfortunately) have set up their own requirements and do not recognize the National Registry, however, just about all of the states do require the 81-hour training program as the basic training program for rescue and ambulance personnel, in accordance with the National Registry. In most of these states, a written and practice examination similar to that of the National Registry should be passed by an applicant in order to become registered within a state. The National Registry requires re-registration every two years.

In line with the concept of recognizing and accepting the EMT as a professional in his own right and part of the team delivering Emergency Medical Care, there has been much discussion of creating stages of proficiency in order to enable the EMT to make a career of his profession and at the same time enable him to expand his knowledge and proficiency by taking advanced courses. Originally, there were

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three stages: (1) the basic EMT and/or EMT-Ambulance, with his 81-hour training period; (2) the next step was originally named EMT-Advanced, but recently this name has been changed officially to EMT-Paramedic; in order to become an EMT-Paramedic it was thought that a training program of about 450 to 500 hours was adequate; and (3) the final stage, the EMT-Hospital, and this group must complete a training program of about two years at a college.

Studies have been made and in some areas of the country a number of EMT-Paramedics have completed a variety of courses and are functioning in cardiac mobile units, starting IV's, communicating with the hospital, giving medication, sending out EKG's, etc. - as seen on the TV program, Emergency. Most of the states lack the proper legislation to allow these paramedics to do their jobs even if they do have the necessary training, and most of the training programs now in effect lack the uniformity that is desired in order to create a nationally recognized and standardized training program for the EMT-Paramedic. The main emphasis in these advanced courses has been on cardiac courses with the purpose of teaching the EMT basic interpretation of EKG's, telemetry, and the techniques of starting IV's and giving injections. Most of these courses are about 100 hours, after which the EMT supposedly can man the cardiac mobile. The National Registry recently has appointed an Ad Hoc committee to study the Paramedic program and this committee has come up with some initial recommendations. Although the total hours necessary to become a Paramedic have been left open, the committee recommended following the guidelines of the Dade-Miami Community College curriculum, and, more specifically, it recommended the modular concept of the training course. This would make the cardiac course mentioned above fit exactly into this training program.

And this is about where we are today. In summary and in general, the concept is now well accepted that no hospital can be an island anymore and that regional Emergency medical systems must be developed. For

the EMT, most states do or will require that their rescue workers must have completed and passed the 81-hour basic EMT training course.

There are still wide discrepancies, however, for example, the state of Illinois now has about 6,000 registered Emergency Medical Technicians and Massachusetts about 2,000, while Connecticut has only 63 and West Virginia only 13. The total number of nationally registered EMT's is now close to 30,000 and the total applications received is now close to 50,000. The concept of the EMT-Paramedic is not yet totally defined but it is beginning to gel up and within a year I expect an official program will be established, emphasizing clinical experience and probably taught along the lines of modular units.

The principal fact emerging is that the EMT now is accepted as a professional in his own right as part of the team in the delivery of Emergency Medicine.

EMT/PARAMEDICS AND EMERGENCY
MEDICAL CARE

LESLIE D. ADAMS

The delivery of quality field emergency medical treatment involves many components, including communications, equipment, transportation and training as discussed by the many other speakers during this Conference. Based on the experience gained in Montgomery County, Maryland, from the development and operation of this type of service I would like to cover two related matters which are particularly of importance to the development of such a service in a rural or remote setting - utilization of personnel and maintaining their level of competency once trained. Before I do that, however, let me just give you some background and insight into our program in Montgomery County.

BACKGROUND

Since 1969, with the impetus of a Federally funded demonstration unit called the "Heartmobile", the development of a comprehensive field emergency medical care program has been underway. Even though Montgomery County is the Northern suburb of Washington D.C. with 550 square miles and around 600 thousand population, the upper half of the County is rural with over 700 farms. Basic emergency medical care has historically been the best available with presently 40 ambulances staffed with a mix of both career and volunteer Emergency Medical Technicians.

Department of Fire and Rescue Services
Montgomery County, Maryland

EMS PROGRAM DESCRIPTION

The effort to improve this basic service began with what is, in most cases, the most time consuming aspect of such an effort - the development of a Paramedic Training Course. It consists of over 200 hours of work including 80 hours of classroom instruction and a minimum of 120 hours of clinical experience over and above the 81 hour U.S. Department of Transportation Emergency Medical Technician - Ambulance course which is one of the prerequisites to our Course. The classroom work is given at our Fire and Rescue Training Academy by local physicians and two registered nurses who are on our staff. The clinical experience is gained from scheduled shifts on the Mobile Intensive Care Units or in the emergency departments or coronary care units of any of four hospitals.

The primary purpose for the Course which is approved under Maryland Cardiac Rescue Technician Training Program Standards is to provide properly trained personnel to staff our Mobile Intensive Care Units commonly referred to as Medic Units. Each student must become proficient or knowledgeable in:

1. Basic anatomy and physiology with particular emphasis on the respiratory and cardiovascular systems.
2. Epidemiology and pathology of coronary artery disease, sudden death, myocardial infarction, angina and cardiac rhythm disturbances.
3. The identification of cardiac rhythm disturbances as reflected on the EKG oscilloscope or paper tracing and their correlation to clinical findings.
4. The indications, action, contra-indications, dosage, route of administration and immediate side effects of some 30 medications carried on the Medic Units.
5. The calculation and measurement of the dosage of these medications.

6. Intravenous cannulation and intramuscular and subcutaneous injection techniques.
7. Basic life support techniques including cardio pulmonary resuscitation.
8. Advanced life support techniques including the use of the esophageal obturator airway, cardiac defibrillation, and radio telemetry communications.

Once the course is successfully completed the student must pass a written test administered by the Maryland State Board of Medical Examiners and a practical examination given by a group of local physicians prior to being scheduled or certified to function as a Paramedic on a Medic Unit.

Each Medic Unit, which operates with a minimum staff of three, is essentially only an extension of the emergency department services of our four hospitals. With the bio-medical communications system, provided by Telecare, Inc. of Houston, our Paramedics communicate with and send EKG directly to the on duty emergency department physician regarding the patient via a patient-side portable and mobile vehicular repeater. With the physicians orders and the medications and other necessary related emergency care equipment and supplies the patient can receive any necessary medical treatment much sooner.

Since the first two Medic Units were placed in service last year their operation, as has occurred elsewhere in the Country, has been nothing but a success. The following statistics for the first six months of operation speak for themselves:

Emergency runs	1768
Patients transported	986
Patients receiving medication/s or IV therapy	476

Resuscitation attempts on patients with cardiac arrest or ventricular fibrillation	179
Long term saves (patient left hospital alive)	33
Saves as percent of resus- citation attempts	19%

My purpose in being here this week is not to brag, although for obvious reasons we are proud of what has been accomplished in Montgomery County. I am here to promote the improvement of emergency medical services and to possibly help you to gain from our experience if you are either considering or have just begun such an effort. Since this conference is aimed primarily at remote or rural emergency medical services development there are two aspects of our program, which I will go into more detail, because they may have direct application to rural services.

UTILIZATION OF PERSONNEL

The fire and rescue services in Montgomery County are supported by a combination of both career and volunteer personnel. As a result the training and operational aspects of the emergency medical services program have been oriented to accommodate both, in terms of availability of time, etc.

All Paramedic Course entrance and completion requirements are the same. Rather than the Paramedic Course being taught during normal 8 - 5 working hours the classes are held once a week for twenty weeks with the clinical experience being scheduled on a weekly basis consistent with the students' availability. Even though the course length is longer we have found that, apparently since more time is allowed between class sessions for outside reading and digesting the material given at the last class, retention by the student of the material covered is much better.

Scheduling of Paramedics on shifts to staff the Medic Units is also accomplished in a manner to accommodate and make economical utilization of all Paramedics. The career Paramedics provide coverage during normal weekday working hours when volunteers are generally not available. And, during night, weekend and holiday hours volunteer Paramedics provide a majority of the coverage. Although scheduling of personnel in this manner does present some problems when compared to the relative ease of scheduling a fully career operation, it can be done on a systematic basis to provide economical 24 hour-a-day staffing.

Of course, a third alternative to the scheduling of personnel does exist and in many cases has to be considered. Coverage can be provided on an on call basis. Although it is a compromise alternative that because of slower response time can directly impact patient care, it may be the only means available to staff such units.

MAINTENANCE OF COMPETENCY

Early in the development of our training program we realized the need to provide a mechanism for the Paramedics to periodically review their basic original course materials and to upgrade their level of knowledge of the "state-of-the-art", so to speak. A continuing education program was developed and is ongoing to accomplish this objective and also to prepare the Paramedics for the recertification test required by Maryland State law every two years.

The Program consists of twelve three hour classes per year (once a month) and a day long symposium held in early summer. Each class session includes a short period of review of Medic Unit operations and cases followed by a physician's lecture. During 1975, the Continuing Education Program consists of a series of lectures on "Anatomy and Physiology" with practical application to emergency care. At the conclusion of the

11 lectures, the Paramedic is tested before being given credit for the course. Efforts are ongoing to develop a course in "Trauma Assessment and Management" to present as the Continuing Education Program for 1976.

In June Montgomery County will conduct the first Continuing Education Symposium for Paramedics. The theme of the day long program is "Arrhythmia Interpretation." This topic was selected after a review of Medic Unit cases showed a need for refresher training in this area. Paramedics from throughout the State have been invited to provide for an interaction of various Paramedic groups. The Symposium, with varying themes, will be presented annually.

The Continuing Education Program is only a portion of the Paramedic Certification maintenance and recertification process. In addition to participating in the Continuing Education Program to maintain Certification during the 2 year period before recertification by the State, a Paramedic must, in each six month period, perform each of the following:

1. Administer at least 10 intravenous solutions to patients at the scene of an emergency or under direct supervision. A minimum of 3 IV infusions are to be performed on Medic Unit duty. The remainder can be performed in a hospital or clinic facility.
2. Monitor at least 5 patients having cardiac arrhythmias.
3. Defibrillate at least 3 patients or demonstrate competency at defibrillation on training manikins under the direct supervision of a certified Paramedic instructor.
4. Administer drugs to at least 3 patients or training manikin under direct supervision of Paramedic Instructor.
5. Ride as Paramedic on a Medic Unit an average 18 hours per month.

Admittedly this is a very aggressive program to maintain the level of competency of our Paramedics. However, our Paramedics have accepted and support this effort in order to make certain that the patients treated by Medic Units will be afforded the best available care.

As each of you involved in related development efforts evaluate your needs in light of available resources you may determine that such an aggressive program is either not possible or desireable. Keep one thing mind, however. Unless your personnel individually, gain extensive continued experience from a large number of patients treated daily or weekly, a continuing education program of some type is essential to maintaining the competency of your personnel following the completion of their initial course of instruction.

CONCLUSION

The improvements we have made to the field emergency medical services in Montgomery County are considered to be only the beginning. As we train more Paramedics we will of course place additional Medic Units in service.

On a broader plan we realize that the program I have described here involves only three or four of the components comprising an emergency medical services system. As such, we have been cooperating in a regional Washington Metropolitan Area emergency medical services systems planning and development effort supported by the U.S. Department of Health, Education and Welfare.

I strongly encourage each of you to support and participate in any and all efforts that will result in improved emergency medical care. Who knows, even you someday may reap the dividends of better emergency medical care.